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The Fifty-First Annual Report

OF THE

UNIVERSITY OF MARYLAND

Agricultural Experiment Station

College Park, Prince George's County, Maryland

1937-38

PUBLISHED BY THE STATION

The University of Maryland
Agricultural Experiment Station

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K. L. Turk, Ph.D., Prof. Dairy Husb.
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M. H. Beery, M.S., Assoc. Prof. Dairy Husb.
C. W. England, Ph.D., Assoc. Prof. Dairy Mfg.

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L. J. Poelma, M.S., D.V.M., Assoc. Prof. Path.
Wm. Gochenour, B.S., D.V.M., Instr. Vet. Sci.

BACTERIOLOGY.

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BOTANY, PLANT PATHOLOGY AND PHYSIOLOGY.

†C. O. Appleman, Ph.D., Prof. Bot. & Plt. Phys.
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C. E. Temple, A.M., Prof. Plant Path.
Ronald Bamford, Ph.D., Assoc. Prof. Botany
R. A. Jehle, Ph.D., Assoc. Prof. Plt. Path.
R. G. Brown, Ph.D., Assoc. Prof. Plt. Phys.
H. G. DuBuy, Ph.D., Asst., Prof. Plt. Phys.
M. W. Woods, Ph.D., Asst. Prof. Plt. Path.
E. A. Walker, M.S., Asst. Plt. Path.
H. G. Shirk, Ph.D., Asst. Plt. Phys.

ENTOMOLOGY.

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L. P. Ditman, Ph.D., Asst. Prof. Ento.
Castillo Graham, Ph.D., Asst. Prof. Ento.
G. J. Abrams, M. S., Inst. Apiculture.

HORTICULTURE.

A. L. Schrader, Ph.D., Prof. Hort.
C. H. Mahoney, Ph.D., Prof. Oler.
E. P. Walls, Ph. D., Prof. Canning Crops
I. C. Haut, Ph.D., Assoc. Prof. Pomol.
F. B. Lincoln, Ph.D., Assoc. Prof. Plt. Prop.
T. H. White, M.S., Instr. Veg. Gard. & Flor.
S. B. Chase, B.S., Asst., Pomol.
J. B. Blandford, Asst., Hort.

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T. C. Byerly, Ph.D., Prof. Phys.
G. D. Quigley, B.S., Assoc. Prof. Poult. Husb.

SEED INSPECTION.

F. S. Holmes, M.S., Seed Inspector.
Ellen P. Emack, Seed Analyst.
Olive M. Kelk, Seed Analyst.

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†Dean of Graduate School.

The Station is located on the B. & O. R. R., City and Suburban Electric Car Line and the Baltimore-Washington Boulevard, eight miles North of Washington, D. C. Telephone—Greenwood Exchange.

Visitors will be welcome at all times, and will be given every opportunity to inspect the work of the Station in all its departments.

The Bulletins and Reports of the Station will be mailed free of charge, to all residents of the State who request them.

ADDRESS:
AGRICULTURAL EXPERIMENT STATION,
COLLEGE PARK, MARYLAND.

UNIVERSITY OF MARYLAND
AGRICULTURAL EXPERIMENT STATION

Volume 51 1937-1938

THE FIFTY-FIRST ANNUAL REPORT OF THE UNIVERSITY OF MARYLAND AGRICULTURAL EXPERIMENT STATION

For The Fiscal Year Ending June 30, 1938

By J. E. METZGER, *Acting Director*

To the Governor of Maryland, the Board of Regents, and the President of the University of Maryland:

In compliance with the provisions of the several acts governing the use of funds allotted to the Maryland Agricultural Experiment Station, there is presented herewith the Annual Report for the fiscal year ending June 30, 1938.

In addition to the detailed financial statement, the personnel changes, and the list of publications, the report contains for the information of the public, a summarized statement covering the purpose, objective, and progress to date on each of the research projects.

Successful research in agriculture has passed beyond the range of possibilities invested in the isolated project system. Agriculture is a complex applied science requiring the services and concerted effort of highly trained and experienced investigators in many branches of science. In recognition of these facts, the work of the Station is being organized increasingly on a problem basis, through integrated and coordinated lines of study. The researches are centered upon broad objectives and by means of subprojects, various subject matter groups make their unit contributions with advantage to the professional interests of the individuals, and to the end that the public be provided with a more complete service.

A number of important additions have been made during the year to the University facilities for teaching and research. The dairy barns were completed, and a new horse barn, a new sheep barn, and a new beef cattle barn were constructed. With these modernized facilities the research program in livestock has entered a new period of development. The gift of the McManus farm with its splendid equipment in poultry and dairying, has greatly increased the material assets of the Station, especially for poultry investigations. In addition, a tract of thirty-seven acres of land located adjacent to the University campus was purchased for the Poultry Department. For a number of years, the field plot work in cereal crops and soil fertility, and in part the work in horticulture, has been located at distant points in the State due to inadequate land facilities. Two adjacent tracts of land, totaling five hundred and eight acres, were acquired during the year. These farms will be known as the Plant Research Farms of the Station, and will be used by Agronomy, Horticulture, and other departments engaged in plant studies.

One of the important developments during the year was the inauguration of an Advisory Council in each of the important agricultural subject matter groups. A total of five such groups were organized during the year. They represent Agronomy, Animal Husbandry, Poultry, Horticulture, and Entomology and Pathology. In general, the purpose of these Councils is to make the work of the University more completely effective in the development of the respective agricultural commodity interests. In the first year the activities of the several groups have been largely in the study of the research program of the Station. It is anticipated that the Councils will be of great assistance in keeping the technical staff advised of the problems facing the industries, and in assisting research workers in adapting the results of fundamental research to practice. There is evidence that the Councils can be a means of keeping the research worker responsive to the needs of the producers and the producer more receptive to the findings of the field and laboratory experiments.

Changes in Personnel

Dr. Harry J. Patterson, who retired from the Directorship of the University of Maryland Experiment Station on October 1, 1937, was associated with its activities from the year of its establishment, 1888. He served first as chemist, then as chemist and Vice-Director, and continuously from 1898 to October, 1937, as Director. The privilege of serving the people of a state in a public capacity for a period of fifty years is an honor no individual can attain except through a devoted ministry. That the Maryland Experiment Station, under his leadership, has rendered useful and efficient service to the people of the State

DR. HARRY J. PATTERSON
Director Maryland Experiment Station
1898-1937

is attested by thousands of citizens who come to it for thorough, unbiased, and reliable information, and for disinterested service in their farm problems. This is the type of scientific research and education to which Dr. Patterson dedicated his talents, and it was only through wise, careful and thoughtful management of the affairs of the Station that he was able to realize his objectives. The large services he has rendered to the people of Maryland are priceless and merit great personal satisfaction. His fine achievements and devotion to duty will always be an inspiration to those associated with him.

Dr. Raymond C. Reed retired from the University of Maryland faculty on February 1, 1938, after many years of distinguished service. He was a graduate in one of the early classes of Veterinary Science at Cornell University and taught bacteriology there for two years after receiving his D. V. M. degree. Dr. Reed engaged in private veterinary practice for several years and then accepted the professorship of Animal Pathology at University of Delaware. While there he developed treatments for sterility of breeding animals that gave him a national reputation in this field. In 1917 Dr. Reed came to Maryland as Head of the Animal Industry Division and Professor of Pathology. Under his direction the foundation was laid for much of the beneficial work now being conducted by the University in livestock farming. Dr. Reed's retirement completes a successful career as practitioner, teacher and administrator.

Resignations

Kenneth A. Clark, Professor of Animal and Dairy Husbandry, resigned to accept the position of Manager of Oldfield Farms, Galena, Maryland.

L. W. Ingham, Professor of Dairy Husbandry, resigned to accept the position of Professor of Dairy Husbandry at the National Farm School, Doylestown, Pennsylvania.

B. E. Carmichael, Professor of Animal Husbandry, resigned to accept the position of Manager of Monocacy Farms, Frederick, Maryland.

Alan E. Bogue, Instructor in Animal Husbandry, resigned to accept a position with the Union Stock Yards, Baltimore, Maryland.

C. M. Mecham, Assistant in Dairy Inspection, resigned to accept a position with the Green Spring Dairy, Baltimore, Maryland.

R. L. Sellman, Assistant in Agronomy and Farm Superintendent, resigned to accept the position of Manager, State Farm Mutual Insurance Company, Baltimore, Maryland.

E. H. Schmidt, Field Assistant in Agronomy, resigned to accept a position with the Federal Soil Conservation Service at Beverly, W. Va.

R. H. Waite, Professor of Poultry Husbandry, resigned to engage in the bonds and securities business in Washington, D. C.

W. A. Frazier, Associate in Canning Crops, resigned to accept a position as Associate Horticulturist at the Arizona Experiment Station, Tucson, Arizona.

W. R. Teeter, Assistant in Animal Pathology, resigned to go into private practice in Cumberland, Maryland.

M. T. Bartram, Instructor in Bacteriology, resigned to accept a position in the Microbiological Laboratory, Food and Drug Administration, U. S. D. A., Washington, D. C.

Appointments

Alfred D. Hoadley, M. S., Assistant in Agronomy.
William Gochenour, D. V. M., Assistant in Animal Pathology.
H. L. Bodily, Ph. D., Instructor in Bacteriology.
T. C. Byerly, Ph. D., Professor of Poultry Husbandry.
Charles H. Mahoney, Ph. D., Professor of Olericulture.
James E. Coddington, M. S., Assistant Professor of Agricultural Economics.
Frederick H. Leinbach, M. S., Professor of Animal Husbandry.
James B. Outhouse, B. S., Assistant and Instructor in Animal Husbandry.
Kenneth L. Turk, Ph. D., Professor of Dairy Husbandry.
J. O. Fernandez, M. S., Research Assistant (temporary) Castor Bean Project at Santa Clara, Cuba.

PUBLICATIONS

Bulletins

Number	Title	Author
410	An Economic Study of the Broiler Industry in Maryland	P. R. Poffenberger S. H. DeVault
411	(Special Bulletin)—Legume and Grass Silage—A Survey of Methods and Results on 380 Northeastern Farms	Committee Report
412	Economy in County Government	E. C. Weitzell
413	Some Factors Affecting the Accuracy of the Babcock Test on Composite Samples of Milk	C. W. England G. D. D'Ambrogi
414	Metabolism in the Corn Earworm. I. Studies on Fat and Water	L. P. Ditman
415	Organization and Operation of Marsh Market in Baltimore and Proposed Improvements	George P. Lachar
416	Winter Barley in Maryland	R. G. Rothgeb W. B. Kemp
417	Effect of Castration of Lambs on Their Development and Quality of Meat	W. E. Hunt DeVoe Meade B. E. Carmichael
418	Does It Pay To Grade Eggs?	P. R. Poffenberger S. B. Shaw S. H. DeVault
419	The Plum Curculio	C. Graham

Scientific Journals

Number

459 Russell, Ralph. Mutual Fire Insurance Companies. Jour. Farm Econ. Vol. 19, No. 3. 1937.

460 Kemp, W. B. Natural Selection Within Plant Species. Jour. Heredity. Vol. 28, No. 10, p. 329-333. 1937.

461 Kemp, W. B. Analyzing a Generalized Interaction into Components. Jour. Amer. Soc. Agron. Vol. 30, No. 5: 419-424. 1938.

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463 DuBuy, H. G. A Method for Extracting Growth Substances from Pigmented Tissues. Jour. Agr. Research. Vol. 56, No. 2: 155-158. 1938.

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472 Woods, Mark W. The Nucleolus in Tulipa. Amer. Jour. Bot. Vol. 24:528-536, 1937.

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474 Cory, E. N. and Elizabeth E. Haviland. Population Studies of Formica Exsectiodes. Annals Ent. Soc. of America. Vol 31, No. 1. 1938.

475 Cory, E. N. and Paul Knight. Observations on Brood X of the Periodical Cicada in Maryland. Jour Econ. Ent. Vol. 30, No. 2. 1937.

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Miscellaneous Periodicals and Proceedings

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FINANCIAL STATEMENT—July 1, 1937, to June 30, 1938

	FEDERAL FUNDS				STATE FUNDS*	OTHER FUNDS	TOTAL
	Hatch	Adams	Purnell	Bankhead-Jones			
DR.							
To Balance June 30, 1937					$11,001.73	$662.91	$11,664.64
Appropriations 1937-38	$15,000.00	$15,000.00	$60,000.00	$21,412.86	87,351.00		198,763.86
Fees, Sales, Endowments and Fellowships						37,966.01	37,966.01
	$15,000.00	$15,000.00	$60,000.00	$21,412.86	$98,352.73	$38,628.92	$248,394.51
CR.							
By Salaries	$12,728.28	$12,877.50	$43,584.63	$14,162.08	$32,122.02	$ 1,550.75	
Labor	798.00	366.88	1,944.47	1,370.74	7,783.11	19,726.18	
Stationery and Office Supplies		12.00	102.75	26.80	379.09	69.29	
Scientific Consumable	63.04	499.85	1,277.88	475,56	829.58	417.07	
Feeding Stuffs	988.84		44.49	2.70	7,307.53	2,335.21	
Fertilizers	54.00		307.91	312.69	1,551.75	49.47	
Sundry	53.22	23.93	1,335.41	319.91	1,234.01	1,236.64	
Communication Service	186.00	99.98	263.42	247.16	251.11	78.13	
Travel	96.09	15.48	2,886.60	1,415.60	804.95	1,759.04	
Transportation of Things	11.42	.50	135.15	1.66	1,117.26	624.37	
Publications			1,956.78	52.20	691.73		
Heat, Light, Water, Power	19.15		23.80		694.00	574.55	
Contingent					9,245.54	866.35	
Furniture, Furnishings and Fixtures			2,130.33	14.00	527.40		
Library			22.74		376.20	15.36	
Scientific Equipment		1,090.26	1,767.62	2,530.88	580.95	25.00	
Tools, Machinery & Appliances	1.96	13.62	1,304.02	90.38	2,793.54	421.17	
Livestock			115.00		10.00	2,905.43	
Buildings and Land			797.00	390.50	5,903.39	735.00	
	$15,000.00	$15,000.00	$60,000.00	$21,412.86	$74,203.16	$33,389.01	$219,005.03
Credit Balance, June 30, 1938					24,149.57	5,239.91	29,389.48
Totals	$15,000.00	$15,000.00	$60,000.00	$21,412.86	$98,352.73	$38,628.92	$248,394.51

REPORTS ON STATION PROJECTS

In order that the public may have more complete information on the investigations now in progress at the Station, there is given in the pages that follow a complete list of the projects, by departments, together with a short description of the purposes of each study and where possible, a summary of the results secured. Farmers and others are invited to develop a personal interest in one or more of these investigations through visits to the laboratories and experimental fields and to follow closely the progress of the work.

AGRICULTURAL ECONOMICS

Work was accomplished during the year on fourteen Experiment Station projects and on two cooperative projects with Federal Agencies. Some of the accomplishments and significant contributions are given below.

FARM ORGANIZATION AND MANAGEMENT

Organization and Business Analysis of Maryland Farms,—Insurance and Credit Problems of Maryland Farmers.—The credit phase of this project was begun in July, 1931, and the results have been completed and published in Bulletin No. 396. Work on the insurance phase of this project was begun in 1935 and during the last fiscal year, the data collected pertaining to the sixteen mutual fire insurance companies in Maryland have been tabulated and prepared for publication. This study covers the following major phases of mutual fire insurance activities: history of mutual insurance companies in Maryland; need for fire insurance on farm property; status, trends and distribution of the sixteen companies in Maryland; organization of companies; types of companies; types of policies issued and coverage; and some special problems of mutual fire insurance companies.

An Economic Study of the Broiler Industry in Maryland.—The results of the first year of this study were published in Bulletin No. 390 and were given in the 1936-37 Annual Report. Records for the second year of the study were taken, analyzed, combined with the first year's records and the results for the two years were published in Bulletin No. 410 in September, 1937. This bulletin reports the results of an economic study of farms specializing in broiler production for the two-year period beginning July 1, 1934, and ending June 30, 1936. Production practices were studied; income, cost and profits of the business were ascertained; and analysis was made of the data to determine the factors affecting profits. On the farms studied, the two-year average number of broilers raised per farm was 8,494.

Investment per farm averaged $1,295; income, $4,646; and cost, including unpaid family labor, $4,164. Income average 54.7c per bird; cost, 49c per bird; and net profit 5.67c per bird. Returns per bird ranged from a net loss of 81c in 1934-35 and 44c in 1935-36 to a net profit of 33c and 40c for the two years respectively, resulting in a net profit of 1.5c and 9.18c per bird for the two years. Feed costs constituted 51.2 per cent of the total cost of production and marketing; cost of chicks, 23.8 per cent; labor, 8.1 per cent; general expenses, 6 per cent; overhead costs, 5.3 per cent; marketing costs, 5.2 per cent; and decrease in inventory, 0.4 per cent. This report offers some recommendations in regard to more profitable production and marketing of broilers.

An Economic Analysis of the Baltimore Milk Market.—This project was inaugurated on June 15, 1935. The objectives of the study are: (1) to ascertain the present status of the Baltimore milk market; (2) to determine the future milk requirements of this market; (3) to collect data which will serve as a basis for improving the milk market situation in Baltimore. Most of the data for the study were obtained from the files in the office of the Maryland Milk Producers Cooperative. The study will be terminated as of August 1, 1938.

An Economic Study and Analysis of Dairy Farms in the Philadelphia Milk Shed.—Since 1925, the Department has been making farm management studies of different types of farming in Maryland. In July, 1936, such a study was undertaken of dairy farms in the Upper Eastern Shore area. Records for the first year of the study were taken in the fiscal year, 1936-37; the second year's records were obtained in the last fiscal year. These records show the organization and profitableness of dairy farms in the area. Some of the significant results, as shown by the 1937-38 records, are as follows: average number of cows per farm, 17.5; milk production per cow, 4,880 pounds; investment per farm, $17,380; farm receipts, $5,260; farm expenses, $3,449; farm income, $1,811; labor income, $942; and labor earnings, $1,334. A comparison of the most profitable and least profitable farms indicates that profitableness is affected by gross receipts, size of herd, production efficiency, efficiency in the use of capital, labor and feed; and the price received for milk and for wheat.

An Economic Study of the Bee Industry in Maryland: Management, Production, and Marketing Practices and Problems.—This study was begun in October, 1936. Records are being taken from most of the important beekeepers in the State. The objectives of the study are: (1) to determine the present status of apiaries in Maryland; (2) to determine the possibilities of honey production as a supplementary source of income; (3) to determine the organization of apiaries and the practices followed in in the production of honey; (4) to isolate the factors that determine the efficiency of production and to evaluate the relative importance of these factors in influencing income; and (5) to secure information on marketing practices, methods of sale and prices. At the present time, bee management records have been obtained for over 100 apiaries in all areas of the State, and complete information has been secured on the uses of and outlets for honey.

An Economic Study of the Hatchery Industry in Maryland.—This study was begun on July 1, 1937. The objectives of the study are as follows: To secure data on the cost of hatching day-old baby chicks; to determine the relative profitableness of the hatchery industry; to determine the factors affecting profits; to compare the cost and hatchability of eggs from pullorum-tested and non-pullorum-tested flocks; to determine the effect of flock breed improvement practices upon the hatchability of eggs; to determine premiums paid for eggs in relation to selling price of chicks; to obtain information needed on which to base suggestions and recommendations for the more profitable production of day-old baby chicks in Maryland. During the last fiscal year, records were obtained from hatcheries in Maryland for the year, July 1, 1936, to June 30, 1937. The study will be conducted for a two-year period and will be completed in 1939, at which time a complete analysis of the results will be made. A brief analysis of the results of the first year's study are given below. The average investment was $5,067 per hatchery, or $5.18 per 100 chicks hatched. The total income averaged $8,039 per hatchery, or $8.86 per 100 chicks hatched. The total cost of hatching chicks averaged $6,772, or $7.14 per 100 chicks hatched. The net profit was $1,567 per hatchery, or $1.72 per 100 chicks hatched. Of the total number of eggs incubated by Maryland hatcherymen, about 68 per cent were from official pullorum-tested flocks valued at 37.7c per dozen; 22 per cent were from unofficial pullorum-tested flocks valued at 30.8c per dozen; and 10 per cent were from non-pullorum-tested flocks valued at 32.0c per dozen. The number of blood tested chicks sold amounted to 82.7 per cent of the total; and non-blood-tested chicks to 10.7 per cent. Maryland hatcherymen sold in Maryland, 53.6 per cent of the total number of chicks hatched; in Delaware, 31.7 per cent; in Virginia, 6.4 per cent; in Pennsylvania, 4.2 per cent; and other states received 4.1 per cent of the total. There are many other pertinent facts revealed by the results of the first year's study which will be presented in more detail at the conclusion of the second year of this study.

A Study to Determine the Source and Quality of Chicks Purchased by Maryland Poultrymen was conducted also. The purpose of this study, which supplements the hatchery project, was to obtain certain information from Maryland poultry producers as to the source and quality of chicks purchased, to obtain further information that may be used in other poultry studies and be of assistance in furthering breed improvement work in the State. This study was conducted by the use of questionnaires mailed to representative poultry producers in all counties of the State. In August, 1937, 2,597 questionnaires were mailed to poultry producers in Maryland. During the fiscal year, 1938-39, it is planned to mail another questionnaire to a much larger number of poultrymen in order to get a better sample. This sub-project will, therefore, be continued another year and will be completed by December, 1938. During the year July 1, 1936, to June 30, 1937, Maryland poultrymen purchased chicks from hatcherymen in 15 states. About two-thirds of all chicks purchased by Maryland poultrymen were purchased from hatcherymen in other states, while only one-third of all chicks were purchased from hatcherymen in Maryland. Chicks were purchased from Maryland hatcherymen last year at an average price of $9.60 per 100 chicks, and from out-of-state hatcherymen at an average price of $11.61 per 100 chicks. Mortality of the chicks purchased from the two sources averaged 12.2 per cent, and 16.1 per cent, respectively. Two-thirds of the chicks were purchased from other states at an average price of $2.01 per 100 chicks more than the price paid for Maryland chicks, while the mortality of chicks purchased from other states averaged 3.9 per cent more than for chicks purchased from sources in Maryland. In Maryland, 89.6 per cent of all chicks purchased were blood-tested, that is, the eggs were from blood-tested flocks and 10.4 per cent were non-pullorum-tested. The average price paid for pullorum-tested chicks, with an average mortality of 13.9 per cent, was 36c per 100 chicks less than the price paid for non-pullorum-tested chicks, with an average mortality of 22.7 per cent. Of the total number of chicks purchased from Maryland hatcherymen, 84.9 per cent were pullorum-tested and 15.1 per cent were non-pullorum-tested; and of those chicks purchased out-of-state, 75.6 per cent were pullorum-tested and 24.4 per cent were non-pullorum-tested. Apparently, there is much need for a hatchery program on breed improvement in the State.

An Economic Study of the Potato Enterprise in Garrett County.—The purpose of this study, which was begun on July 1, 1937, was to obtain information on the production and marketing practices followed by potato growers in Garrett County and to determine the effect of these practices on yields and returns to growers. Records were obtained the first year on 103 farms. Most of the farms in this area were classified as general self-sufficing in the 1930 Census. The farms averaged 183 acres in size, of which, in 1936, 62.8 acres were devoted to crops. The potato acreage averaged 4.4 acres per farm. Average receipts per farm from all sources were $2,728 in 1936. Average expenditures per farm were $1,553, leaving a cash farm income of $1,175. The average yield of potatoes was 237 bushels per acre; the average net income per acre was $127.93 and the average cost of growing potatoes was $103.44 per acre. It is planned to continue this study another year in order to have comparative results for two years on the same farms.

Types of Farming and Agricultural Adjustments in Maryland.—This study, which was begun on June 1, 1937, is concerned primarily with an evaluation of the agricultural resources in Maryland and the types of farming which prevail. Particular emphasis is placed on an analysis of the physical, economic, and biological factors which have shaped agriculture in the past. An appraisal of these causal factors furnishes a background for an undertaking of present day agriculture and gives some indication of the probable direction of future development. During the fiscal year, basic data were assembled and maps prepared showing concentration of different crops and livestock. Detailed maps have been prepared showing the soil series, productivity of soils, erosion, rainfall, temperature and type-of-farming areas in Maryland. With the cooperation of the U. S. Department of Agriculture, the maps showing the soil series and productivity are being reproduced in color.

MARKETING

An Economic Analysis of the Present Status of the Marketing of Fruits and Vegetables by Motor Truck in New York City and Other Markets to Which Maryland Produce is Transported.—In August, 1934, the University of Maryland Agricultural Experiment Station in cooperation with the Farm Credit Administration, The New York Agricultural Experiment Station, and the Port of New York Authority undertook to make a study of the transportation of fruits and vegetables by motor truck from Maryland to the New York market. This study was also conducted on a cooperative basis with the other Northeastern states. The data for the Northeastern states were tabulated and the material published by the New York Agricultural Experiment Station in cooperation with the respective states. To help complete the picture of the marketing of fruits and vegetables in Maryland, the Maryland Agricultural Experiment Station studied the transportation of fruits and vegetables by motor truck in the Baltimore, Washington, D. C., and Washington County areas. A bulletin was issued by the Maryland Agricultural Experiment Station covering the costs involved in the transportation and marketing of fresh fruits and vegetables from the three areas in Maryland. During the past year, work was done on a second phase of this project, namely, the costs of operating trucks used in the hauling of fruits and vegetables to market.

An Economic Study and Analysis of the Baltimore Fruit and Vegetable Market.—To help complete the picture of the marketing of fruits and vegetables in Maryland, a project was inaugurated on July 1, 1935, for the purpose of securing information on the Marsh Market, a farmers' wholesale market in Baltimore, which would aid in the solution of the problems of inadequacy and inefficiency in the entire wholesale distributive process in Baltimore. The total receipts on the Marsh Market average about 3.3 millions of dollars annually, approximately one-fourth of which comes from producers in other states and three-fourths from Maryland producers. Over three-fourths of the Maryland receipts come from Baltimore and Anne Arundel counties. Canners receive 48.2 per cent of the total carloads; jobbers, 45.7 per cent; and the remainder goes to retailers,

Marsh Market, The Farmers' Wholesale Market in Baltimore, showing congestion during the early morning hours. The covered market area will accommodate about 126 trucks, yet during the peak season daily arrivals range between 400 and 600 truck loads.

peddlers, hucksters, etc. The study indicates that the facilities of the Marsh Market are inadequate to handle the volume of business during at least seven months of the year. The study indicates some of the ways in which the facilities and services of the market may be improved to handle the traffic congestion and to lower the costs of marketing.

The Effect of Motor Truck Transportation of Produce Upon the Marketing Facilities of Baltimore.—The purpose of this study, which was inaugurated early in 1936, was to obtain information about the origin of receipts of fruits and vegetables in the different markets in Baltimore, the channels and cost of distribution, marketing facilities, congestion on the different markets and to suggest a plan or plans for reorganizing the markets in such a way as to facilitate the movement of produce and reduce the cost of marketing. The study covers the railroad terminals, boat wharves, commercial wholesale markets, jobbing markets, chain stores, and public retail markets handling fruits and vegetables in Baltimore. This study has been completed and the results have been published in Bulletin No. 409. The results of this study show that the wholesale fruit and vegetable dealers in Baltimore received 36,072 carloads of produce in 1935. Of this amount, 17,481 carloads arrived by motor truck; 9,559 carloads arrived by rail; and 9,032 carloads arrived by boat. These fruits and vegetables were distributed as follows: To out-of-town buyers, 14,321 carloads; to retailers in the city of Baltimore, 12,562 carloads; to canning factories in Baltimore, 5,175 carloads; to chain stores, 3,393 carloads; and to unknown buyers, 621 carloads. The results of this study show that the five wholesale markets receiving fruits and vegetables in Baltimore are split rather than coordinated in their activities. Out-of-town buyers must visit several markets to obtain a full line of produce. The different markets have different selling hours, thus the buyers must spend more time than is necessary to obtain their supplies. The cost of cartage from one market to another within the city amounts to nearly $500,000 annually. The markets that receive produce by truck are antiquated and congested beyond their capacity. A reorganization and consolidation of these markets would solve many of the present marketing problems of the fruit and vegetable industry. The publication contains specific recommendations as to how the markets may be improved to facilitate the movement of fresh fruits and vegetables.

Status Trends of Agricultural Cooperation in Maryland.—This study was begun in July, 1936, and is the first complete study to be made of the agricultural cooperative movement in Maryland. The objectives of this study are three-fold: it aims (1) to develop briefly the history of the agricultural cooperative movement in Maryland since 1900; (2) to show the present extent and character of farm cooperation; and (3) to bring out the points of strength and weakness in the cooperative movement at the present time. The results of the study show that there was little cooperative activity in the State prior to 1900. During the next ten years, a large number of associations were formed but many were unsoundly organized and soon failed. Since 1930, the cooperative movement has proceeded upon a sounder basis, and in spite of the depression, substantial gains have been made. During 1936, 68 cooperatives operated in Maryland. Thirty-two were primarily concerned with the marketing of farm products; 17 with the purchasing of farm supplies, and 19 with the providing of various farm services. The total Maryland business done by these associations amounted to over 16 millions of dollars, of which approximately 83 per cent represents the value of farm products marketed cooperatively. Approximately 40 per cent of the farm operators in the State are members of one or more cooperative organizations. The outstanding weaknesses of the cooperative movement appear to be the neglect of sound business practices and a lack of understanding of cooperative principles.

The Marketing of Eggs in Maryland With Special Reference to the Baltimore Market.—This study was begun on July 1, 1937. The purpose of the study was to ascertain the source of supply of eggs on the Baltimore market and receipts by rail, boat and truck; to determine the channels of distribution of eggs, such as trends in the selling of eggs on a commercial basis, outright sale on a cash basis, returns to producers, and the cost of marketing eggs from the producer to the consumer; to determine the basis of price quotations in Baltimore and the relationship between retail prices and the quality of eggs; and to determine the consumer preference for eggs. Information has been obtained through personal interviews and by means of questionnaires and schedules from 256 retail stores, 30 retail market men, 5 meat packers, 3 egg brokers, 2 chain stores, and 27 wholesalers and jobbers. Detailed records of monthly cold storage holdings and movements from 1930-37 have been obtained from four cold storage houses in Baltimore. Information has also been obtained on storage facilities and costs. Fifty representative retail stores were selected for special study and since January, 1938, eggs have been candled at each of these stores once each month. A consumer questionnaire has been prepared and during the summer of 1938, a large number of consumers will be interviewed to ascertain the consumer demand for eggs in Baltimore. Transportation agencies will be interviewed to obtain the cost of delivering eggs from the farm to the market. Hotels and restaurants will be contacted to ascertain their demand for eggs. This study will be completed during the fiscal year, 1938-39, and the results will be available for publication sometime during the latter part of 1939.

A Study to Determine the Relative Net Price Received for Eggs Sold Based upon U. S. Government Grades and Eggs Marketed by Other Methods.—This study was conducted during the year as a special phase of the project, "The Marketing of Eggs in Maryland, With Special Reference to the Baltimore Market." The objectives of this study were as follows: to obtain data on the price received for eggs sold based upon U. S. Government grades; for eggs sold through special markets such as institutions, hotels, restaurants, etc.; and for eggs sold by other methods such as to hucksters, to local stores, etc.; to determine the relative cost of marketing eggs by the several methods and the net price of eggs; to determine the relation of size and quality to the price of eggs based upon the price received for the various Government grades. As a basis for determining whether it pays to grade eggs, the results of 15 producers in Baltimore and Harford counties who sold their eggs to the Purity Creamery Company in Baltimore on a U. S. Government graded basis were compared with 15 producers from the same locality who sold their eggs indiscriminately to hucksters, retailers, wholesalers, etc. All costs entering into the transportation and selling of eggs were included and an attempt was made to determine the net price received for eggs by the respective two groups of

Montgomery County Farm Women's Cooperative Market, Bethesda, Maryland. Through this market, 87 farm women of Montgomery County sell such products as baked goods, fresh fruits and vegetables, dressed poultry, eggs, fresh meats, dairy products, etc. This association is very successful and has attracted national attention.

producers. The study indicates that it pays to sell good quality eggs on a graded basis, but that it apparently does not pay to sell poor quality eggs on a graded basis. The study indicates further that size influences the price of eggs as well as quality.

FARM TAXATION AND FINANCE

The Farm Tax Problem in Maryland.—Research studies in farm taxation have been conducted continuously in Maryland since April, 1930. Each year certain phases of the major project are completed and new ones undertaken. Several bulletins and mimeographed reports have been issued by the Department since 1930. During the last fiscal year, a study was made for the purpose of determining the advisability of instituting an income tax for the State of Maryland and the amount of revenue such a tax would yield. Studies were made in several counties for the purpose of determining the need for certain changes in the general property assessments. The results of these studies show that the assessments in many of these counties have been inequitable and a reassessment is needed. Several counties have made reassessments and have used the results of these studies as a guide in the work. Considerable assistance was given the Highway Planning Survey in its study of highway conditions in Maryland. Assistance was also given the Maryland Farm Bureau and the Maryland State Grange in preparing statistical tax reports for the Joint Tax Committee of these two organizations.

Probable Economy and Increased Efficiency in Local County Government Through Redistricting the State.—This project was begun on July 1, 1934. The objectives were (1) to study local county government from the standpoint of the present set-up, (2) cost of administration, and (3) to determine the probable economy and increased efficiency resulting from the redistricting of the taxable resources and reorganization of the functions of county government. One phase of this study was completed during the year and the results were published in Bulletin No. 412. A plan for reorganizing and consolidating the present system of county government is suggested. Several of the possible advantages to be obtained through a consolidation of the present county units are listed as follows: (1) Consolidation would tend to place both the services and costs of government on a more equitable basis. (2) It would aid the smaller and poorer counties by utilizing without unjust discrimination the relatively greater wealth of the richer counties. (3) It would eliminate many duplicating expenditures. (4) It would make possible a unit large enough and involving a budget large enough to be of efficient size. (5) It would make possible a centralized and authoritative governmental unit. (6) Consolidation would increase the possibility of more equality in assessments and taxation, now needed throughout the State. (7) This plan would make possible the survival of a system of sound democratic local government, namely home rule county government. Another phase of this study entitled, "A Comparative Study of Local Governments in Maryland," has been conducted during the fiscal year. The purpose of this phase of the study is to show what advantage, if any, would result if the incorporated towns were consolidated with their respective county governments.

LAND ECONOMICS

A Study of Agricultural Adjustments in Kent County, Maryland.—This is one phase of a project which was begun on April 15, 1935, entitled, "A Study of Adjustments in Farming by Regions and Type-of-Farming Areas from the Standpoint of Agricultural Adjustment and Planning, Including Soil Conservation". This earlier project was a joint study of the Maryland Agricultural Experiment Station, the Bureau of Agricultural Economics and the Agricultural Adjustment Administration. This project was completed in September, 1935. In July, 1936, the Department of Agricultural Economics of the University of Maryland cooperating with the Agricultural Adjustment Administration and the Soil Conservation Service inaugurated a study entitled, "Farm Organization and Soil Management Practices in Relation to Agricultural Conservation and Adjustment". This study was conducted in the dairy, tobacco and truck farming areas of the State to determine the land use adjustments necessary to maintain erosion control. The study was completed during the fiscal year 1936-37. The "Study of Agricultural Adjustments in Kent County Maryland" was started on July 1, 1937, for the purpose of comparing the results of the Agricultural Adjustment Program in Kent County under the 1936 Regional Agricultural Adjustment Program and the 1937 Experimental Agricultural Adjustment Program, in an effort to determine the net effects of the two programs and what advantages the Experimental Program had over the Regional Program, if any. The results of the study reveal that the farms in the 1937 Experimental Program had increased acreages of wheat, corn, and total depleting crops over the previous year under the Regional Program. There was a substantial increase in the acreage of conserving crops and a decrease in idle land in both 1936 and 1937, but the decrease was less under the Experimental Program than under the Regional Program. Paid diversions decreased under the Experimental Program but practices increased. These changes were probably due to factors outside of the programs because similar changes of even greater degree were found under the 1937 Regional Program. Payments were larger under the Experimental Program than they would have been under the Regional Program. The advantages of the Experimental Program lie chiefly in certain of its administrative features which should be incorporated in the regular program. However, their adoption would probably not increase the degree of participation under the program. This particular project was completed during the fiscal year 1937-38, with the exception of a study of the tenant problem in Kent County.

An Economic Study of Land Utilization in the Tobacco Region of Southern Maryland.—This project has been carried on since 1936 by the Maryland Land Use Planning specialist of the United States Department of Agriculture in cooperation with the Department of Agricultural Economics of the University of Maryland Agricultural Experiment Station. The purpose of this study was to collect data on the present land use of tobacco farms in Southern Maryland, to ascertain the extent of erosion, to determine the systems of farming most commonly practiced, to study the basic factors such as crop requirements, rotation, physical condition of the region and economic and social characteristics of the people, which in part may underlie destructive and wasteful systems of land use. The apparent undesirable use of much of the land in Southern Maryland, coupled with low standards of living and income inadequate for necessary public services, led to the development of this study. The results of the study indicate that the soils and climatic conditions in Southern Maryland are adaptable to a wide variety of enterprises, yet the region devoted more than two-thirds of the crop land harvested to the production of tobacco and corn. About 40 per cent of the tillable land is moderately to severely eroded. The study indicates that the farms which followed a more diversified type of farming had considerably less erosion than did those which specialized in tobacco and corn production. Incomes were almost 50 per cent higher on farms which followed a system allowing little idle land and diversifying in farm enterprises. Recommendations for alleviating undesirable conditions include: (1) changing the use of crop land from highly specialized crop production and considerable idle land to a diversified system of crop production and a minimum amount of idle land; (2) divert the use of submarginal agricultural land from farming to forests, recreation or other non-farm use; (3) use steep and highly erodible land for forestry; rolling and less erodible land may be used for pasture; and the more undulating to level areas should be devoted to crop production; (4) combine other farming enterprises with tobacco production so as to lower risks which are associated with one-crop farming, and which will permit the use of desirable soil conserving practices.

AGRICULTURAL ENGINEERING

A Small Electric Milk Pasteurizer.—Work is being resumed on a project previously started to develop a small electric pasteurizer for the farmer with from 5 to 10 cows. The advance in work thus far is too limited to draw any conclusions.

Electrically Heated Hot-bed Studies.—Work of an exploratory nature was conducted to determine the effectiveness of electric lights in heating hot-beds. The work indicated that a large amount of work would be required in such an investigation due to the differences in the reactions of various plants to light. No conclusive data has been obtained at this time.

Grain Storage on the Farm.—This project has been carried on for two years in cooperation with the United States Department of Agriculture to determine the grade of wheat which may safely be stored on the farm and the type of storage which will best preserve or improve the quality of such wheat. After two years of intensive study, certain conclusions may be drawn as follows: Only sound dry wheat should be placed in any storage. Wheat up to fifteen per cent moisture can, in general, be stored for short periods without loss but should be under close observation. No wheat over fourteen per cent moisture should be placed in long-time storage, i. e., storage for over six months. Wheat will not dry appreciably after being placed in ordinary storage bins. Materials such as straw, posts, etc., when placed in the wheat cannot be expected to dry grain in a humid climate such as that in Maryland. Drying by ventilation, either natural or by fan, is slow and ineffective. Wheat of over fourteen per cent moisture should be dried before long-time storage is attempted. In general this will require an artificial dryer.

AGRONOMY

The Department of Agronomy includes the work in both Crops and Soils. The Crops work consists primarily in plant improvement by means of breeding, selection and crop management. The Soils work is a combination of field and laboratory experiments in which the chemistry of the soil receives the principal attention.

Corn Variety Tests and Selections.—This project has been active for many years. It has had for its object the selection and establishing of superior strains of field corn for Maryland. It has been highly effective in that it has encouraged private seed corn producers in the State to devote their efforts along scientific lines of corn breeding. Practically all of these growers have submitted their stocks for comparative trials supported by this project. As a result, weaknesses have been brought to light, which, in many cases, the breeder has been able to correct.

Results have been published from time to time in bulletins such as No. 237 and No. 329.

Wheat Varietal Tests, Environmental Studies, Plant Selections, Hybridization.—This, an old project, has been one of the most fruitful ones conducted. Not only have commercial varieties of wheat been evaluated as to adaptation, disease resistance, and general usefulness, but also two improved strains have been distributed by the Maryland Experiment Station. The first of these, an adapted strain of Mammoth Red, was released sixteen years ago. It has since become the most widely grown "bearded" wheat in Maryland. The second strain, known as Leapland, was selected and named by the local station. It is a "beardless" wheat resembling Leaps Prolific, but is more productive, uniform, and has larger heads. It is becoming the principal awnless wheat in the State. In addition to varietal improvement, this project has furnished data for a classical study on the environmental factors influencing wheat production. The fact that several varieties have been rotated on the same fields for more than forty years, contributes a unique value to this work. Not only has this long-time study explained varietal responses and distributions within the State, but it has also been of national importance because of its priority in the use of statistical methods in studying the relationship between crop response and weather. Bulletin No. 297 reports the work in detail. The project is being continued with special emphasis being placed on the development of strains resistant to scab, a destructive wheat disease in Maryland.

Barley Hybridization and Selection for Winter Hardiness and Smooth Awns.—This work was started in 1926 for the purpose of developing a winter-hardy, smooth-awn variety which would be suitable for Maryland. Tennessee Winter has been grown as the standard variety and had given satisfaction from the standpoint of cold resistance. However, the rough or barbed nature of its awns is very annoying to men who handle the crop, as well as to animals that eat the straw. On the other hand, the "beardless" or hooded barleys have not been satisfactory because of brittle heads and weak straw. Therefore, if winter barley was to fill the place that feed economy demanded that it fill, it was necessary to develop a suitable variety. As a result, several strains with smooth awns, high productivity, and fair cold resistance have been developed by the Maryland Station. Two of these, namely, 13-6 and 19-8, have been distributed for commercial use. More than 10,000 bushels of seed was produced for sale by private growers in 1937. As these new barleys are not as winter-hardy as desirable, breeding work is being continued to that end. A Station bulletin is ready for publication.

Sweet Corn Seed Production and Breeding.—Three lines of work are being carried under this project, namely, (1) variety and hybrid testing, (2) production of inbred lines, (3) the crossing of inbred lines for the purpose of discovering more suitable hybrid combinations. Annual field tests for commercial and experimental varieties have been run on the same farm since 1930. Data on productivity and field performance have been reported annually. In this way canners and growers have been kept in touch with the rapid development in hybrid sweet corn. As a result, it is estimated that about 50 per cent of the state acreage is now being planted to crossed seed. The Station now has on hand a number of 5-generation inbred lines suitable for trial crosses. Work to date indicates that out of this material will come new hybrids with greater productivity than is possessed by hybrids now in use. The intention is to continue the work along present lines with, perhaps, somewhat more emphasis on quality.

Studies on the Reproductive Capacity of the su (sugar) Factor in Relation to the Su (starch) Factor in Corn.—This is a

Ear samples from a group of promising U. S. D. A. dent corn hybrids being tested for use in Maryland. Many hybrids have been disappointing, but some are outyielding open-pollinated varieties 10 to 15 per cent.

technical project set up for the purpose of obtaining information which will aid in practical corn improvement. An attempt has been made to determine the effect that the presence of the genetic factor which produces the sugary endosperm, has upon the response of the corn plant to its environment. To this end a mixed population of plants has been studied for seven successive generations. As sufficient data have been collected, they will be analyzed and the results reported as soon as possible.

The Effective Sex Ratio in Corn and Its Relation to Yield.—This is a project, quite technical in nature, which was designed to shed light on some of the fundamental principles involved in corn improvement. Essentially, it is a study of the relationships existing between plant characters which contribute to number of gametes, i. e., pollen grains and ovules, and those which contribute to size of seed. Thus it has involved a study of both ear and tassel characters and the influence that environment has upon them. Field work has been completed and the data have been partially analyzed.

Development of Dent Corn Hybrids Specifically Adapted to the Corn-Growing Areas of Maryland.—The growing importance of hybrid dent (field) corn, warrants investigation relative to the production, multiplication, and comparison of this type of corn under Maryland conditions. Accordingly this project was started in 1937. It has the following specific objectives: (1) to determine what existing hybrids are superior to native varieties; (2) to establish inbred lines for use as parental stocks; (3) to try new combinations of existing parental stocks; (4) to study methods for reducing the cost of hybrid seed; (5) to determine optimum cultural practices for hybrids which show superiority over a wide area. In 1937 forty-one hybrids were included in trials at College Park, eight hybrids at the Ridgely sub-station, and six hybrids in farm observation trials. The fact that about three-fourths of the hybrids did not surpass ordinary native varieties, indicates that hybrids should be recommended only on the basis of performance, preferably over a period of several years. In addition to field trials in 1937, a number of inbred lines were multiplied, new lines were started, and numerous experimental crosses were made. This work will be expanded in 1938. Annual reports will be made public.

Hay Investigations.—A total of seventy-five strains of domestic and foreign alfalfa are in the test plots. These alfalfa varieties and strains are being tested for adaptability, yield, quality, and time of maturing, in relation to other farm work. The red clover studies in progress combine adaptability with reference to disease and suitability for use in conjunction with other forage plants under Maryland conditions. In addition strains for local production are being developed. Comparative tests of both foreign and domestic seed are included in the experiments.

Annual Legumes—Soybeans.—Several hundred varieties of soybeans have been tested for hay and grain over a long period of years. Most attention has been given to varieties especially suitable for forage. In this respect, Virginia, Wilson, and Wilson Five, have been outstanding varieties. Because of the recent

An experimental white sweet corn top cross grown in the nursery at College Park. Hybrid sweet corn is well established in Maryland, but there is still room for improvement.

interest in Maryland in varieties suitable for oil production, several varieties used for this purpose were included in trials at several locations in 1937. This work will be repeated in 1938.

Improvement of Permanent Pastures in the Several Soil Provinces of Maryland.—Objectives: (1) to determine if strains of permanent pasture plants can be selected which are better adapted to conditions in the different parts of Maryland than existing commercial stocks; (2) to learn the conditions necessary for most economical yield of these strains; (3) to propagate and put into commercial use any superior strains which may be obtained. Local strains of Kentucky bluegrass, orchard grass, and white clover, have been isolated, which differ markedly in yield, response under close clipping, and chemical composition. Some of these differences are very distinctly inherited through the seed in bluegrass and to a less extent in white clover. Seed stocks of promising strains are being multiplied and tested. Recent bulletin on pastures: No. 373, "Permanent Pastures in Maryland," and a journal article: "Natural Selection Within Plant Species," have been published.

Tobacco Investigations.—All of the tobacco research work of the Station is carried on in cooperation with the U. S. Department of Agriculture. The field plot work is located at Marlboro. The program involves studies in crop and soil management in relation to yield and quality of tobacco for the cigarette trade, tobacco nutritional studies, curing and storage, tobacco diseases, and tobacco breeding.

Dairy Rotation.—The purpose of this study is to determine the extent to which the total supply of feeds needed in a dairy rotation may be produced on the Maryland dairy farm. The crops are corn silage, winter barley, and alfalfa-alsike-timothy hay. There is evidence that the dairy farm can produce all of the silage, all of the hay and about 60 per cent of the feed grains needed by the herd.

Effect of Organic Matter on the Fertility of Leonardtown Loam.—This is a study of the effect of turning under lespedeza, sweet clover, timothy, and stable manure, on the organic matter content of a Leonardtown loam soil. The object is to see if the organic matter content of the soil can be maintained or improved by the use of these organic materials. A two-year rotation of barley and tomatoes is used in this study. After four years of turning under these crops and residues on small plots there has been very little effect upon the total organic matter content of the soils, and no evidence that any are a maintenance program for organic matter. The continuous growth of grass has given increases in organic matter at the surface. The sweet clover and manure treatments have increased the yield of tomatoes and barley considerably. The use of sweet clover and manure have produced a temporary increase in the total number of bacteria. In the fall after vegetative growth has ceased there was little difference in the total number of micro-organisms. The fallow plots or no green manure or cover crop were the lowest in the total number of micro-organisms throughout the season. In view of the more or less negative results and the possibility that the present location of the plots is to be used for a new building site it is planned that the work on the present project be concluded this fall. It will then be expanded and relocated on the new farm.

A combination terrace and farm lane. This type of construction could be used to advantage on hundreds of Maryland farms.

Field Studies of the Fertility Requirements and Management of Important Soil Types.—In 1917 cooperative experimental plots were established on several farms throughout the State. During this last twenty-one years 22 of these experimental fertilizer test plots have been in operation. Test plots were located in sixteen of the twenty-three counties of the State. The objective of these tests was to obtain the fertilizer requirement of the various soils under different cropping practices. Briefly, the results have indicated that the greatest needs of Maryland soils are phosphoric acid, lime, organic matter, potash and nitrogen. This need is somewhat in the order listed, however, there will be variations according to the different soils. The majority of Maryland soils have been so extensively cropped since they were plowed up by early settlers that a complete fertilizer has to be used for the most profitable returns. Recently the need of organic matter is becoming more and more noticeable. At present only two such test plots, Princess Anne and Ridgely, are in operation.

Princess Anne. The yields on the Princess Anne field have continued to increase favorably. This is believed to be due largely to the increase in fertilizer applied to this soil and possibly better management. The saline origin of these soils and the heavy subsoil underlying it in all probability limit the feeding area of the normal crops. The use of lime probably has caused the removal of far more plant food than would normally be the case. This has made the need for more fertilizer greater. The incorporation of organic matter along with the fertilizer on the Princess Anne plots may have been the needed stimulus for better crop yields. This suggests that perhaps more emphasis should be placed upon the working into the soil of more organic matter, lime and fertilizer. It is believed that these soils resemble to a certain extent some of the reclaimed soils in Holland. There the use of several tons of lime per acre is required before any crops can be grown. Perhaps if a rather soluble form of lime not too high in magnesia were used extensively on these soils, together with organic matter and sufficient fertilizer, the production of these soils could be raised considerably. After a high level of fertility has been reached the maintenance will not be as expensive.

Ridgely. The fertility plots are divided into two sections known as A and B. Section A is a study of the effect of the nutritional elements on the fertility of this soil, and Section B is a determination of the proportion and amounts of fertilizer materials needed. The crop yields on Section A at Ridgely have still continued to be quite low. The laboratory work which was done on these soils during the past winter indicates that these soils have not increased or even maintained a very appreciable amount of available plant food. Since these soils are of a similar origin to those at Princess Anne perhaps a part of the difficulty may be due to limited rooting area and insufficient plant food. This conclusion is suggested from the results obtained on the Section B which was fertilized at a heavier rate and with complete fertilizers. The soil is sampled and a complete analysis run, one in each rotation, to determine the residual fertility of the soils.

Fertilizer Studies with Early Potatoes and Sweet Potatoes.— This is a continuation of work started in 1924 on a leased farm near Snow Hill, Maryland. In this early work the primary objects were to determine the best source of nitrogen for potato fertilizer, obtain a value for the use of green manures, compare analyses and rate of application of fertilizer and determine the suitability of concentrated fertilizers for potato production. Briefly the conclusions of this early work were that a 6-6-5 fertilizer was probably the best formula in regard to nitrogen and potash. When the organic and inorganic forms of nitrogen were combined, better yields were obtained. It was impossible to obtain enough organic nitrogen by the growing of green manuring crops to take the place of this form of nitrogen in the fertilizer. An application of 2,000 pounds per acre seemed to be the most profitable rate of fertilizer application. In 1932 potato fertilizer work was started on the Pilchard Farm, near Pocomoke, Md. This new work continued a comparison of sources of nitrogen material with and without supplements of limestone. The results of this recent work with white potatoes indicate that the source of nitrogen is not an important factor when the acidic residues left from the different forms of nitrogen are compensated for by the use of lime material. The mixing of lime material as a filler in the fertilizer gave much better results than when the lime was applied separately to the soil. The cheapest forms of nitrogen, such as ammonium sulfate and urea ammonia liquor, were entirely satisfactory and gave excellent yields as long as there was a sufficient amount of dolomitic limestone mixed with them to make a nearly neutral fertilizer. In the work at Snow Hill, sweet potatoes were included in the rotation with the white potatoes. The fertilizer formulae used in that work were 3-8-5, 3-8-7 and 3-8-10. The results indicated that the 3-8-10 probably was the best fertilizer. In the present work at Pocomoke sweet potatoes were included in a separate rotation. Here many different fertilizer formulae were tried. The nitrogen varied from none to 6 units and the potash from 10 to 20 units. The average results for the last six years indicate that 3-8-15 fertilizer is far superior to any of the others. The two fertilizers which gave the next best yields were the 2-8-10 and 3-3-15. There was very little difference between these two. The 3-8-10 which is commonly used, was not as good as a 1-8-10. This indicates that perhaps the 2-8-10 is a very good fertilizer to use for sweet potatoes because of the proper balance of nitrogen and potash. The good results with 3-8-15 may be entirely due to the greater amount of fertilizer applied.

Fertilizer Formulae and Analyses for Late Potatoes.—This work aims to determine the best fertilizer analysis for the growing of late potatoes in Western Maryland. The units of nitrogen, phosphoric acid and potash were varied to give many different fertilizer analyses. The nitrogen was applied in 3, 4, 5, and 6 unit ratios. The phosphoric acid was used in units of 4, 6 and 12, and the potash unit range was 5, 7 and 10. The results, so far, indicate that the use of a 4-8-8 or 3-12-6 fertilizer, according to the soil needs, are the best fertilizer formulae for late potatoes in Western Maryland.

Efficiency of Soil Fertility Management.—This work was started to study the fertility changes produced in soil under different but actual farm management practices. A total of thirty-three individual farms have been sampled monthly during the growing season and chemical determinations made upon the available nutrients found in the soil. The results after five years, indicate that the crop yields on the farms studied have increased slightly. The pounds per acre of fertilizer applied is practically the same although the fertilizers have become more concentrated. The chemical studies indicate that for most of the soil the available potash has been maintained at practically the same level as when the study was started. The available phosphoric acid has decreased since the beginning of the work. The amount of organic matter also has tended to decrease. Lime materials have been applied more regularly. Although five years is a comparatively short period of time on which to base results of such a study, due to influence of season, it appears as if the farmers are increasing their yields but are not maintaining or

A broad base type of terrace on a field planted to soybeans as a soil fertility test crop.

increasing their fertility reserve in the soil. This may be the result of more regular liming, greater yields, insufficient fertilizer or a decrease in the sorption complex.

The Effect of Fertilizer on Fertility and Grass Population of Pastures.—This is a study to determine the effect of present pasture management practices on pasture fertility. It is concerned with the improvement in quality of pasture turf by the use of commercial fertilizer. The effect of the different fertilizers upon the grass population was also noted. After four years, the results indicate that a fall application of fertilizer is more effective than a spring application. The use of a fertilizer quite high in phosphoric acid and carrying a small amount of potash seems to be the most effective in maintaining a high state of fertility. The use of manure along with the phosphoric acid and potash also stimulated the growth of grass. The movement of phosphoric acid downward into the soil is very slow. The fall application of the fertilizer seems to have favored the penetration of the phosphorus.

A Study of the Methods of Obtaining Total Exchange Capacity and Exchangeable Base Content of Soils.—In order to properly evaluate the results of some fertilizer tests and the fertilizer needs of soil, it has been necessary to determine the amount of plant food held in a readily available form and also the total capacity of the soil to hold plant food. This is spoken of as the exchangeable bases and the total exchange capacity of the soil. There are several different methods which have been proposed to determine these values. Since none of the methods have been adapted by the Association of Official Agricultural Chemists it was thought that a study of several of the methods on soils of known fertility response would indicate which would be the best for Maryland soils. The results obtained by the various methods varied. All of the several different methods tried have advantages and disadvantages. Since the work has not been completed it is impossible to say just what methods will be the most desirable.

Rapid Soil Testing.—For nearly 50 years this Agricultural Experiment Station has been requested to determine the fertility needs of many different Maryland soils. At first these were largely for lime, and resulted in the development of the Wheatstone bridge for use in soil testing, and the Veitch method of determining the lime requirement. This demand has increased and expanded, until in addition to lime, the kind and amount of fertilizer to apply is requested. Recently there has been an increasing demand for a determination of need of the so-called rarer elements of a plant food, as magnesium, manganese, boron, zinc, copper, etc. In order to meet this demand an accurate, cheap and rapid method had to be developed. The method now in use was selected for its adaptability for the varied conditions of Maryland soils. Although some of the present technic was worked out about five years ago, it is still undergoing development. It is believed that the service now received by the Maryland farmer is one of the most reliable known. Over 10,000 samples were tested during the past year.

A section of the new Plant Research Farm showing location of soil conservation experiments.

A Laboratory Study of Some Soils from the Ridgely Field.—The tomato yields, and to a certain extent, wheat, barley and corn yields have been too low for some of the plots at the Ridgely Experiment Station. Some of these low yields have been consistent even though the fertilizer application has been fairly high. These plots were sampled and chemical studies made to determine the cause of the low yields. This study has not been completed but the results to date indicate that in the low yielding plots, the amounts of available phosphorus are very low even though phosphorus has been applied. The use of manure and green manures has increased the amount of available phosphorus. Moderate applications of lime have increased the amount of available phosphorus. Some of the plots which were very low in their tomato yields were also very low in their exchangeable calcium and magnesium. The study indicates that perhaps the sorption complex of the soil is so low that the applied plant food does not remain in an available form long enough to supply the need of the crop. The low amount of available plant food and the small amount of fertilizer applied suggest that there is insufficient plant food applied to these plots. This study has been very helpful in working out a new treatment for the A Section at Ridgely this spring.

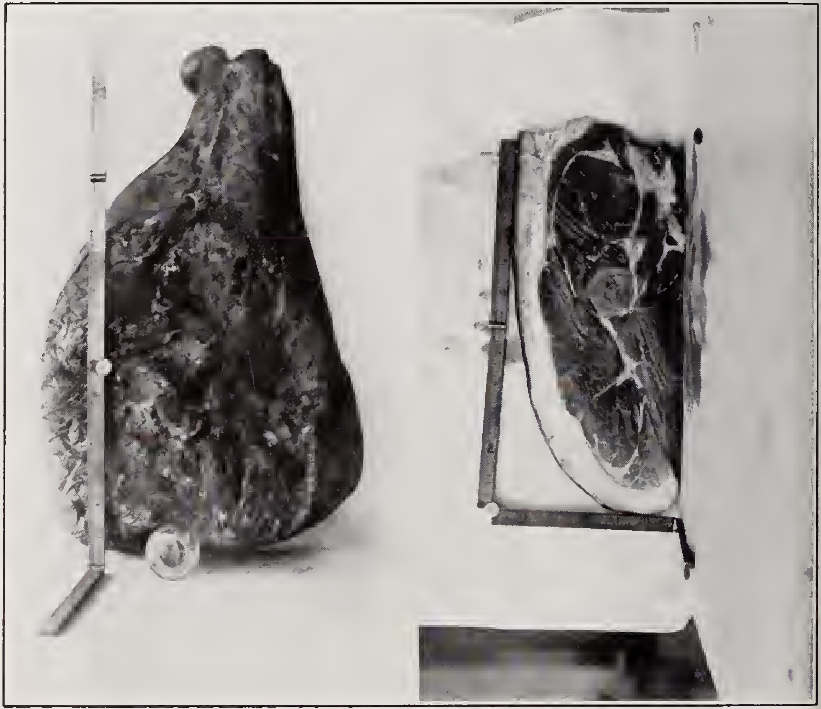
Chemical Studies of the Causes of the Hardpan in Leonardtown Soils.—Typical Leonardtown soils were sampled by horizons and brought into the laboratory for chemical and physical determinations. The object was to determine if the hardpan layer was the result of an accumulation of certain chemical constituents. For comparison, a similar study was made on some Sassafras soils. The results showed that the accumulation of any of the chemical elements in the hardpan was no greater than that in some of the adjoining layers. This indicated that the layer was formed by some means other than chemical cementation. While the mechanical and chemical analyses showed that variations occurred in the profiles within a given soil type, these variations were small compared to those existing between the two series. The wide differences in the physical and chemical constitution of the profiles of the two series pointed to a dissimilar parent material. The high clay content in the lower part of the B and the upper part of the C horizon was a contributing factor in the formation of the hardpan in the Leonardtown soils.

ANIMAL AND DAIRY HUSBANDRY

During the past fiscal year research work in the Department of Animal and Dairy Husbandry has been carried on in animal nutrition, animal breeding, animal health, meats and in milk studies. At the present time there are seven Federal and State research projects in progress at the Maryland Station; six of these are a continuation of work which has been carried on for several years, while the project, "A Small Electric Milk Pasteurizer", was started within the past fiscal year. A brief summary of these projects is herein reported.

Study of Factors Which Involve the Production of Pork Products of Desirable Quality and Palatability.—This project, a continuation of the original project entitled, "A Study of the Quality of Maryland Hams", was started in 1937 and has been conducted by the Maryland Station in cooperation with the United States Department of Agriculture Bureau of Animal Industry. Its purpose is the improvement of farm cured hams. During 1937-38 the special phase of the general problems under investigation was "A Study of Salt Penetration and Moisture

Loss in Hams during the Curing Process". Forty paired hams, averaging fifteen pounds each, were cured in an 8-2-2 mixture (8 pounds of salt, 2 pounds of sugar, and 2 ounces of saltpeter, for every one hundred pounds of meat) at +38°F. Twenty left hams were cured in brine (above mixture dissolved in approximately four and one-half gallons of water), and the remaining twenty right hams were dry cured. At intervals of five, fourteen, thirty, forty-five, and sixty days, six paired hams (three dry-cured and three brine-cured) were pulled. A slice, about a half-inch wide, was taken from each ham just below the H-bone, the different muscles represented in the slice being analyzed for salt and moisture. Hams lost weight in the dry-cure and gained weight in the brine-cure. The meat of the hams dry-cured lost moisture, while the meat of the hams brine-cured failed to gain in moisture. This would indicate that the gain in weight observed in the hams during the brine-cure was due



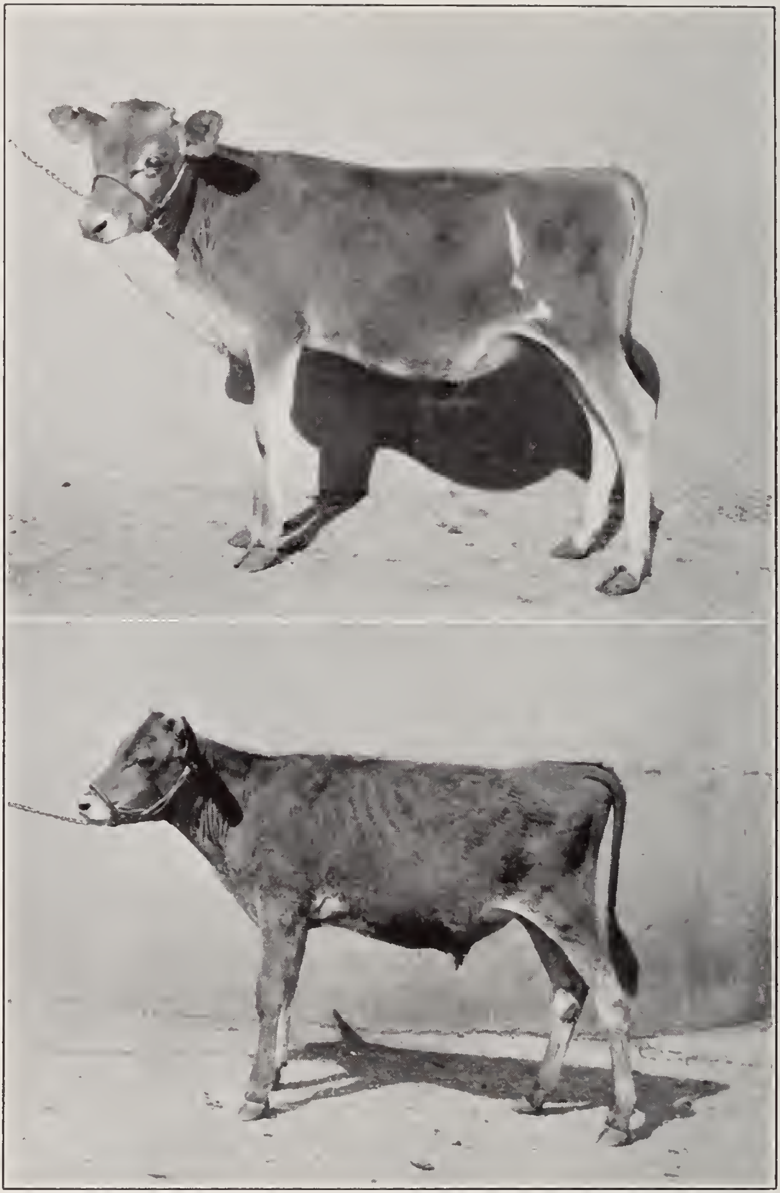
Exterior view of ham aged in connection with temperature controlled experiments at the Maryland Experiment Station. Cross section view of ham of superior quality aged in connection with temperature controlled experiments at Maryland Experiment Station.

primarily to salt deposition. As the curing process progressed, the salt appeared in the greatest concentration first in the sartorius muscle, followed in order by the semi-membranosus, the adductor muscles, the semi-tendinosus, the wastus-internus, the rectis, the femoris, the vastus externus muscles, the biceps femoris and the vastus intermedius muscles. It appears that salt penetrates the ham from the faced side, apparently little absorption taking place through the skin. After being in cure 2.78 days per pound, the hams had nearly reached their maximum salt content. The brine tested 14.7 per cent salt at the beginning, dropping to 11.7 per cent at the end of 14 days, then gradually fell to 10.7 per cent, at which concentration it remained fairly constant until the end of 60 days.

Control of Contagious Abortion in the Experiment Station Dairy Herd.—This project is a continuation of the work reported in Maryland Station Bulletin No. 331, "Contagious Abortion in the Experiment Station Dairy Herd", published in February, 1932, and is being carried on cooperatively with the Department of Veterinary Science. Records are now complete for a thirty-year period, showing the number of abortions in the herd by yearly periods. In June, 1929, the herd was divided, the cows positive to the agglutination test for Bang's Disease were removed, and a negative herd established. The herd has been accredited since January, 1935. Blood tests are taken at frequent intervals and a complete history of the breeding and calving record kept on each animal in the herd. Within the next year additional data on this project will be available to supplement that published in Bulletin No. 331, and to determine the number of abortions in a herd negative to the Bang's Disease test.

Growth Data on Dairy Farm Animals from Birth to Freshening Age.—In this project, monthly weights are taken on all the heifers raised from birth to freshening age. The object is to secure normal weights for heifers during growth to use as a future means of checking the growth of dairy heifers to determine if they attain normal growth. The first results obtained in this study were reported in the Forty-Eighth Annual Report of the Station.

The Effect of Feeding Kelp Meal Upon Improving the Breeding Efficiency of Dairy Cattle.—This project is being carried on cooperatively with the U. S. Bureau of Fisheries and the Kelco Manufacturing Company. The object of this project is to determine the effect of feeding kelp meal upon improving the breeding efficiency of dairy cattle. Dairy heifers of approximately one year of age of the same breed are paired off for use in this feeding trial. One heifer of each pair serves as a check animal.



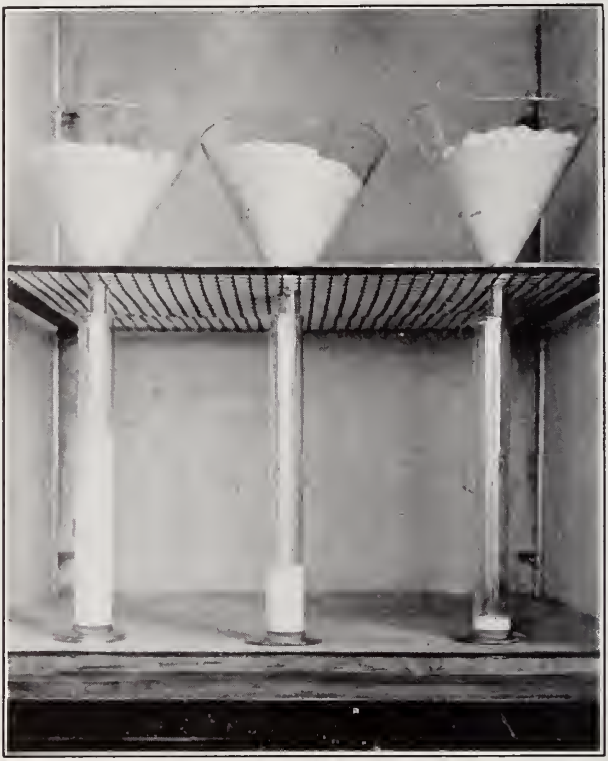
Dairy calf fed limited amount of milk to four months of age before weaning to hay and grain. Dairy calf fed limited amount of milk to one month of age and then weaned ot hay and grain. Both pictures taken at five months of age.

The second heifer is fed in addition, kelp meal at the rate of 4% of the grain ration. Otherwise, both heifers are fed exactly the same. Complete data as to breeding history, condition at calving, weight and condition of calf and growth, and development of heifer will be secured for analysis at completion of the project. It is planned to secure data on at least 25 pairs of animals. Sixteen pairs have been placed on trial to date. Insufficient data have been secured to date to warrant drawing any definite conclusions regarding the project.

Input as Related to Output in Milk Production.—This project is being carried on in cooperation with the Bureaus of Dairy Industry and Agricultural Economics, of the U. S. Department of Agriculture. The objectives are: (1) to test the application of the principle of increasing and diminishing returns to milk production; (2) to extend the present knowledge of the fundamental relationship between rate and method of feeding different feeds and milk production of dairy cows; (3) to make information available in a form which will permit the determination of the most economical rate of feeding under various price conditions. Six groups of five cows each matched as to breed, age, weight, previous production, advancement in the lactation period, etc., are being fed at different rates in relation to their milk production. One group serves as a base group and is being fed according to the Haecker Feeding Standard. A second group is being fed roughage alone. The remaining four groups are being fed at the rate of 1 pound of concentrates for every 2 pounds of milk produced; 1 pound for every 3 pounds of milk; 1 pound for every 4 pounds of milk; and 1 pound for every 6 pounds of milk. Complete data will be secured as to the computations of rations, grading, analyzing and weighing of feeds and determination of milk and butterfat production and effects on body weights and condition of cows. The data secured will be analyzed by appropriate qualitative and quantitative methods. The project has been in progress slightly over a year. The data secured to date are not complete enough to show any definite trends or to warrant any definite conclusions.

A Tracer for Use in Cream for Manufacturing Purposes and a Method for Its Detection.—This project was begun in June, 1937. Its purpose is to find a tracer that can readily be detected for use in heavy cream for manufacturing purposes. A method for the detection of annatto in heavy cream has been devised. This method involves the precipitation of proteins by alcohol; extraction of fat by gasoline; removal of serum and treatment with sodium hydroxide; filtration of serum and treatment of dried filter with stannous chloride. A pink color indicates the presence of annatto. This test is sensitive to one part in

400,000. The effect of freezing, heat, homogenization, acid production and neutralization on the sensitivity of the test will be studied. Standards are yet to be developed for annatto strength when used as a tracer. Progress at this time indicates that annatto may be used satisfactorily as a tracer in sweet, untreated cream.



Experiment in connection with effect of added materials on drainage from whipped cream. Left—Nothing added. Center—Sodium alginate added. Right—Gelatin added.

A Small Electric Milk Pasteurizer.—This project is being carried on in cooperation with the Department of Agricultural Engineering. The purpose of the project is to determine the materials, size, proportion and other design factors necessary for the construction of a practical small electrical milk pasteurizer. In the early tests the objective will be to attain conditions which are standard for present commercial pasteurizers.

In all tests, records are being kept of current, voltage, power, heating time and temperature at various points in the milk mass. In the later tests, bacteria counts, flavor and cream line determinations will also be made. Uniformity of heating is an important factor in effective pasteurization so as to have all milk reach the desired temperature without raising some to a point where the cream line will be impaired. The effect of sloping electrodes, size and shape of electrodes and shape of container on the uniformity of heating, without an agitator, will be determined. The effect of size, shape, speed and location of an agitator on the uniformity, will be determined for the most desirable container. The elimination of an agitator would be desirable if uniform results can be obtained without its use. In all final tests reading of temperature at various points in the milk and surrounding air, amperes, volts, and watts, will be recorded at regular intervals. Records are being kept of killowatt-hours used, of bacteria counts before and after test, of cream line for various periods of storage and of effect on flavor. Thermometers are being read in a regular sequence and the first thermometer is being read at the end of the series to determine the rise or fall during the reading time. Record is being kept of the titratable acidity, pH, Esch. coli count, total bacteria count, creaming ability and flavor, and odor before and after test (pasteurization).

ANIMAL PATHOLOGY

Blackhead (Enterohepatitis) in Turkeys.—Previous work has demonstrated practical measures for control and has substantiated facts concerning the etiology of the disease. New information on methods of isolation and cultivation of the causative agent (Histomonas meleagridis) has been recently established. Improvement of technique which permits isolation directly from the liver has been developed. Previously cultures were possible only from cecal content, which was heavily contaminated with other micro-organisms. In acute liver lesions histomonads were found in large numbers, usually unassociated with other protozoa. In chronic liver lesions Pentatrichomonas gallinarum was frequently found associated. By some investigators this latter protozoan was thought to be the cause of blackhead. A new medium has been developed which can be sterilized by heat. The histomonads grow as well or better than on media previously used and remain viable for a week to ten days. Media formerly used could not be sterilized by heat and the source of the bacteria associated with the histomonad cultures was in question. Efforts at purification of histomonad cultures by the use of the micromanipulator or sedimentation have been unsuccessful. The latter method permits of some reduction in bacterial contamination.

These improvements in media and isolation methods should permit a more detailed study of Histomonas meleagridis.

Bang's Disease—Udder Infection With Brucella Abortus.—This study was continued with milk samples from cows showing a suspicious blood reaction to the agglutination test. The animals used had never shown a positive reaction (1 to 100 or higher) and were retested at intervals to prove that they were not recently infected and just beginning to react. The volume of work has been limited because few herd owners retain animals which continue to give suspicious reactions. Records of many herds have been examined and many blood samples have been drawn preliminary to each sample of milk secured. In no instance were Brucella abortus organisms found in milk from cows that repeatedly reacted in only the lower dilutions of the agglutination test of their blood. Previous work at this Station showed that cattle having a blood serum and milk serum titre of 1 to 200 and above eliminated live Brucella organisms in their milk in 70.3 per cent of the cases. When the blood and milk sera titres were 1 to 100 Brucella abortus was isolated from the milk of 25 per cent of the animals. Those cows reacting to the agglutination test in dilutions less than 1 to 100 were eliminating abortus organisms in 3.1 per cent of the cases. Further investigation indicated that this latter group was developing infection. From the present study we have no reason to believe that milk from animals that persistently react to blood tests in dilutions of 1 to 50 or less may cause undulant fever in persons consuming it.

Running Fits (Canine Hysteria, Fright Disease) In Dogs.—Two lots of commercial dog biscuits, one manufactured in Maryland, caused the disease under field conditions. These were fed experimentally to dogs and again caused running fits. One lot of this food required approximately three pounds fed over a period of six days to produce the usual symptoms. The other lot produced the same clinical picture from one feeding of approximately one-half pound. Animals affected showed great excitability, mental disturbances, wild barking and howling, champing of the jaws and frothing at the mouth, convulsions and coma. Recurring but less severe attacks continued for about 48 hours when the animals again appeared normal. If feeding of the biscuits were continued, the attacks became more frequent, prostration developed and death resulted. Several pounds of the more toxic lot were kept at room temperature in a closed jar for approximately six months. In a later trial with this stored material, feeding of two to three pounds over a period of three to four days was required to reproduce symptoms. Autopsy findings, bacteriological and other examinations gave no indications that infectious or parasitic agents or deficiencies were concerned in the etiology. The data, so far, point to a toxic material in the feed as the cause. This may be of microbial origin or arise from chemical changes in the feed before or after baking.

The Effects of Proteins on the Internal Organs of Chickens.— The average mortality in laying flocks has arisen from about 10 per cent to an approximate 25 per cent. This increase seemed to coincide with the introduction of commercially prepared poultry feeds. These commercial feeds have contained protein from several sources and in varying proportions. An attempt has been made to determine the effects of such feeding upon the internal organs, particularly the liver and kidneys. Groups of chicks have been fed a basal ration to which have been added skim milk, soya bean meal, meat scrap and vacuum dried fish meal, respectively, to approximate protein levels of 16, 22, and 28 per cent with a control group on the basal ration above. At about monthly intervals, birds from each group have been killed for autopsy. Appropriate specimens from the liver and kidneys of each have been sectioned and stained for microscopic study. These studies have demonstrated pathological changes in the organs studied. The groups fed dried skim milk and soya bean meal showed these changes in direct proportion to the percentage of protein, without a decrease of severity with increase in age. The groups on meat scrap and fish meal showed more marked changes than those on the other feeds, with little variation from low to high protein concentration but with a decrease in severity of changes in the older birds.

Bovine Pyelonephritis—Diagnosis, Treatment and Control.— This infectious disease of the urinary tract of cattle has been found to occur in several herds in Maryland. It has also been shown in several other states to cause a similar condition in horses, but no such case has been diagnosed here. The present studies aim at early diagnosis, attempts at successful treatment of affected animals and the development of appropriate methods of control and eradication. Diagnosis has been made upon microscopic study of urine sediment, the characteristic staining and arrangement of the causative agent being significant. This disease has been shown present in 18 cows in about eight herds in widely separated sections of the state. One case was studied at the laboratory and treatment was attempted with phenothiazine. Improvement followed the five-day treatments of 100 grains three times a day but this was only temporary and the decline during the week between treatments was rapid. The urine showed a rapid change toward normal while the drug was being eliminated, but at no time did the causative agent disappear completely. Under field conditions the method of control suggested has been the prompt elimination of infected animals and proper disinfection. In several herds urine samples from all animals have been regularly examined.

Infectious Equine Encephalomyelitis—Treatment and Control.—Previous publications from this Station referred to a disease of horses and mules which appeared in epidemic form about the start of this century on the Eastern Shore and in Southern Maryland. Another severe outbreak occurred in the same sections in the summer and fall of 1933, with recurrences of less intensity and extent until the present time. The present disease has been shown to be due to the Eastern type of virus. During each year of the present outbreak, efforts at treatment have been made with anti-serum and at protection with anti-serum and vaccine. Treatment has not proven satisfactory with the local disease. Prophylaxis with serum has been highly effective, but results with vaccine have been inconclusive. In addition to control by protective inoculations information has been widely disseminated concerning the protection of animals by proper stabling and the use of fly sprays, since salt water mosquitoes have been incriminated in the spread of the Eastern type of the disease. During the past season cases appeared in one section of one of the Southern Maryland counties. Prophylaxis with anti-serum was effective.

Periodic or Recurrent Ophthalmia of Horses and Mules (Field Studies).—Periodic Opthalmia or Moon Blindness has been known to occur for many years. The name of the disease indicates its most constant characteristic, an inflammatory condition of the eye which tends toward recurrence, the cycles having been interpreted as having connection with the phases of the moon. Many other agents and conditions have been included in the list of possible causative agents—environment, food deficiencies, parasites, bacteria, heredity, allergy and viruses. The last named claim has been accepted as the most likely of all in the light of present knowledge. Bacterin made from cultures of Flavobacterium ophthalmiae has been distributed for several years in Maryland. This was undertaken after reports indicated that its use experimentally by Dr. E. C. Rosenau of the Mayo Foundation had given promise. This product has been distributed to practising veterinarians or has been used by members of the staff in cooperation with horse owners. Reports indicate that the bacterin is being used in treatment and prophylaxis. For the former purpose the results seems to show that it is as efficacious as foreign proteins, such as sterile milk. In a great many instances there seems to be definite indications that the interval between recurrences is lengthened. In a few cases seen intimately there seems to have been a complete cessation of the disease and a return to an approximate normal structure in the eye. Veterinarians and horse owners are inclined to believe that this material has distinct merit as a preventive in unaffected cases.

The Biological Method of Diagnosing Pregnancy in Mares.— The early diagnosis of pregnancy in mares is of value in that it allows rebreeding during the same season. Because the breeding season for throughbreds extends only from the middle of February to the middle of June, and since mares of this breed are a total loss unless they produce a foal, such procedure is essential to a productive industry. Pregnancy diagnosis is possible by manual examination of the generative organs per rectum and by the demonstration of specific hormones in the blood and urine. Blood offers a more suitable medium than urine since the hormones appear in it in about six weeks as compared to about three months for urine. The chemical demonstration of the hormones in the blood by present methods has not proven satisfactory in our experience. The biological method, in which immature female rats are injected with serum from mares, has proven highly satisfactory in two seasons. In the first trials in 1936, about 120 mares were examined. In one group from which samples were drawn, between the 40th and 80th day after the last service, the efficiency of the test was over 90 per cent. A great many samples were submitted after a longer period, so that the accuracy for the season was much less. In 1937, samples were sent in from about 280 mares, most of which were drawn within the proper time limits. The efficiency for a diagnosis of pregnancy was 96 per cent and for barrenness was 86 per cent. These percentages might have been somewhat higher except for the fact that in some instances male rats had to be used for injection trials. The changes in the genital organs of this sex do not seem to be quite as definite as is the case with females. Efforts are being made to further shorten the time required for testing in order that the results may prove of even greater value.

Streptococcic Septicemia of Horses and Mules.—This specific disease of equines has been encountered for several years in sporadic farm outbreaks. Veterinary literature contains few accounts of diseases which simulates the condition studied. The most marked symptoms noted have been sudden onset of inappetence, depression, distress, high temperature, recumbency and death. In a few outbreaks all of the animals on the farm have succumbed. The mortality rate has been consistently 100 per cent. The lesions noted at autopsy have been those of an acute septicemia, greatly resembling those seen in anthrax. A hemolytic streptococcus has been constantly recovered from all organs.

This germ has been pathogenic for rabbits, but not for other experiment animals usually used for laboratory diagnosis. Trials have been conducted with rabbits injected with specific bacterin. Later exposure of these rabbits to virulent material gave indications of the development of varying degrees of resistance. Efforts to produce an anti-serum by injecting virulent material in increasing amounts were not wholly successful, since protective trials with this serum in rabbits were indefinite and inconclusive. Treatment with Sulfanilamide will be attempted as soon as an opportunity presents itself.

Bovine Trichomoniasis—Diagnosis, Treatment, Control and Eradication.—This protozoan disease of the genital tract of cows and bulls has caused damage in breeding herds in this and other states. Its presence was brought to light when Bang's disease was eradicated from large numbers of herds. In order to cope with the problems for the benefit of herds already infected and to prevent the introduction of the disease into other herds, efforts have been pushed to collect all possible data. The disease had been diagnosed from clinical manifestations in a number of dairy and beef herds. The protozoan, Trichomonas bovis, has also been definitely demonstrated microscopically in several herds. Efforts at diagnosis by means of agglutination, complement-fixation and precipitation tests are also being made. The clinical manifestations in our experience have been mainly early abortions and difficult impregnation. Some early abortions have in all likelihood escaped notice and failure to settle has aroused the suspicion of the breeder. Douching the cows with antiseptic solutions has been instituted in several herds. Bulls have been treated in the same way since they are incriminated as spreaders of the infection. In one dairy herd the cows have been kept open through three heat periods. Infected and exposed bulls are used upon the same class of females. Young unexposed bulls are selected for service of virgin unexposed heifers.

Trichinosis—Diagnostic Methods.—The diagnosis of trichinosis in swine is one of the major problems facing health authorities and sanitary officers. In cooperation with Dr. G. F. Otto of the Johns Hopkins University, efforts were made to produce an antigen suitable for an intradermal test in swine, to work out such a test for use in the field and to diagnose the infestation in swine by blood examinations. Suitable swine were infested artificially with the parasite for use as test animals and material for antigen. For the latter purpose the infested swine were destroyed, meat was harvested, digested and the parasites separated and collected. The antigens were prepared and made up into varying dilutions which were injected into infested animals by the intradermal method. The reactions proved specific within certain time limits. Procedures for applying the test under field and slaughter-house conditions have not been worked out. Tests of blood for the demonstration of specific precipitins were also made and gave promise of having value in diagnosis under laboratory conditions.

Bovine Mastitis—Diagnosis and Control.—Bovine infectious mastitis has caused inestimable loss to dairymen all over the world, through decreased milk flow, increased cost of care and veterinary service and forced sale of cows for slaughter. Preliminary studies with samples from herds all over the state have indicated that the disease is widespread. Diagnostic methods were improved by the use of the Hotis test as an adjunct to leucocyte counts and microscopic studies of the incubated milk samples. Records of samples examined showed that 78 per cent of the mastitis studied was caused by Streptococcus algalactiae and 22 per cent was non-specific in nature. In one large dairy herd all cows were examined and separated on the basis of the presence of the specific streptococcus, regardless of the clinical condition of the udder. Following this separation only one new case has developed. Different milking machines are used for the infected cows and the teat cups are immersed in antiseptic solution between cows. Frequent examinations are made of the non-infected animals, particularly at freshening. New cows are also examined before addition to the herd. It appears perfectly practical to control the disease by isolation of affected animals and the use of simple sanitary practices. The development of herds free of infectious mastitis also seems feasible.

BOTANY, PLANT PHYSIOLOGY AND PATHOLOGY

Cytogenetic Studies in the Genera Gladiolus, Tulipa, Ipomoea and Verbena.—This study was started in 1932 and has for its general purpose the study of the so-called wild species of these genera and their relation to the commonly cultivated types in each group. This is all based on the assumption by many that a large part of the economic plants are the result of hybridization and that a repetition of the same procedure will produce newer and supposedly better types. Two methods of approach have been utilized and eventually attempts will be made to correlate these results. The first approach has been to study the chromosomes of each individual form and the second procedure has been to attempt to hybridize these same members of a genus. Up to the present we have determined the chromosome number of all the species and varieties that we have succeeded in obtaining. This information has all been published except that recently acquired on the genus Verbena. In one of the genera (Tulipa) we have also been able to study the morphology as well as the number of chromosomes, the assumption being that we can secure a qualitative factor as well as a quantitative one in measuring relationships. Whether these quantitative and qualitative determinations are of any value depends largely upon the results of the work on hybridization. Practically all our efforts are being devoted to this part of the work at present. Thus far the results have been very variable but technical difficulties, time of flowering, diseases and other factors have tended to confuse the results obtained. In all cases it seems true that most of our commercial types are the result of previous hybridization but that the particular species involved are as widespread as those which have been reported seems to be open to question. In two cases the qualitative character of the chromosomes (Tulipa, Ipomoea) seems to be the limiting factor whereas in the other two cases (Gladiolus, Verbena) the quantitative character of the chromosomes seems to be correlated with hybridization.

Botanical Survey of Maryland.—This is a continuing project intending to bring together all the information on the vegetation that covers Maryland, and on its relation to the inhabitants of the State. This data is gathered to some extent by special surveys but for the most part in travel about the State in connection with other work, and from the material sent in from year to year with requests for information. These bulletins have been published on the State flora: Wild Legumes of Maryland, 1905; Maryland Weeds and Other Harmful Plants, 1911; and, Maryland Grasses, 1930. Recently a small work on the wild flowers of the State and one on a flora of Solomons Island for the use of summer school students have been prepared but not yet published. The intention is to make a work listing all the plants of Maryland with their use or detriment and with some means of identifying them. The records of Maryland plants are maintained in the University herbarium.

Identification of Plants and Diseases.—This is a service project carried on continually and contributes to the Botanical Survey. Hundreds of specimens are submitted for names by members of our staff, especially county agents and others in the Extension Service, and by citizens of the State. Some, due to years of experience, can be named at once. Some, on account of fragmentary material and lack of information as to source, take hours of work or comparison with the National Herbarium in Washington.

Plant Poisonous to Livestock.—The intent of this investigation is to determine the distribution of poisonous plants in Maryland and to supply means of recognizing them by stock owners and veterinarians. This surveying has been carried on for the

Water Hemlock (Cicuta maculata), the plant most suspected as a livestock poison in Maryland wet land. The white flowers, resemble carrot flowers, but the leaflets are much larger. The clusters of deliciously flavored tuberous roots is very poisonous.

past two years and in addition a large number of the cases of poisoning reported have been visited in cooperation with the Livestock Sanitary Service and with Maryland veterinarians. Approximately 25 species of plants have been found causing death of livestock. About 5 of these are responsible for most of the loss. Some of these are fairly well known. One of the worst, the water hemlock, is not known to most people. Several hundred species have been tried on guinea pigs as a preliminary or basic survey of general toxicity. Guinea pigs were killed by laurel, dogbane, paspalum ergot, foxglove, water hemlock, aralia berries, daffodil, calla, wild cherry and amianthium. Feedings of sheep and guinea pigs with Star of Bethlehem or Southern Snowdrop were negative but field indications point to considerable loss from it. A bulletin on this work is in preparation.

Varieties Resistant to Disease.—This is a project in which preliminary studies have been made on disease resistance in various crops such as peas, potatoes, strawberries, and tobacco.

The object of this study is the production of strains and varities of economic plants resistant to diseases, whether caused by pathogens, by viruses, by the environment, by control measures, or by any combination of these; to study the nature of resistance to disease and the morphologic, physiologic, genetic, or other factors to which resistance to a disease may appear to be due. As many geneticly different varieties and strains of a species as could be obtained have been tested under natural or artificial conditions for maximum infection by the causal organism of the disease under investigation. This is followed by individual selection, multiplication, infection tests, re-selection, and so on, for resistance and type. The Fusarium wilt disease of tobacco has become established in the soils of some Maryland farms and in other states. In one case, about 50 per cent of the tobacco plants died in July and August, 1937, on account of wilt. The use of a part of the land where the wilt was most prevalent has been set to tobacco plants from 65 different sources including four varieties from the Marlboro Station and 61 varieties and strains from farmers. These farmers were selected by the County Agents of the five tobacco-growing counties on the basis of type of tobacco grown and wide geographical distribution. Each lot of plants has been set in four replications of ten plants each. This test is intended to determine whether or not any of the tobacco now used on Maryland farms has any resistance to wilt. Resistance to disease in plants is genetic. In almost all species some resistance to one or more diseases exists naturally. In most cases, strains or varieties resistant to the disease in question have been found; but it has been necessary to apply the procedure in genetics to improve the type or increase the resistance.

Pea Root Rots.—This project was started in 1933. The work on the root-rots of peas was begun in 1918 and has been revised and expanded from time to time. The object is to measure the effectiveness of rotation combined with soil fertility treatments in the control of pea root-rot. A field 300x470 feet on the A. W. Feeser Company Farm No. 4, Silver Run, Md., was used. This field was divided into four large plots 300 feet long, and all of these were crossed by three different fertilizer treatments, low and high commercial fertilizers, and manure 10 tons plus acid phosphate. The plots running across all three fertilizer treatments were planted as follows:

Peas, 5 years in succession.

Peas, 1st, 3rd and 5th years, with corn in the other years.

Peas, 1st and 5th years with corn, tomatoes and beans in the other years.

Peas, 1st and 5th years with hay and corn in other years.

The soil work on this project was done by the Agronomy Department and the Department of Horticulture cooperated on the horticultural phases of the study, such as taking yield records. Prevalence of root-rot of peas was recorded for each of the various treatments every year. The five-year rotation was completed with the 1937 crop. The results of the investigation should be ready for publication during the year.

Tobacco Diseases.—Investigations on tobacco diseases have been mainly confined to two plant bed diseases, namely, wildfire and downy mildew. Wildfire has been a problem for the past 20 years. Blue mold (downy mildew) was observed for the first time in Maryland in 1931 and has been increasing in severity each year since, when in 1937 this one disease alone resulted in a loss of a million dollars to the Maryland tobacco growers. The plan is to improve on already recommended control methods, and to find new, efficient and more practical control measures adapted to Maryland tobacco plant beds. In controlling wildfire a 4-6-50 Bordeaux Mixture spray is used, together with careful plant bed sanitation. Blue mold is more difficult to control. Various methods of control have been tried in four tobacco counties. Several spray materials have been tested as distinctive preventative measures. Entire beds, and portions of plant beds have been treated with gas both before and after the disease has made its initial appearance. Both the pan evaporators and the newly created wick type of evaporators were used under known thickness and weights of tobacco bed cottons. Records were kept of the hourly gas content under the covers, while daily observations were made of the plant bed for possible early and manifested blue mold symptoms. Climatological conditions were recorded. Finely ground and coarse crystal gas treatment under varying thickness of cottons was tried after the disease appeared in the bed. Wildfire is controlled in plant beds by 2 to 3 applications of Bordeaux Mixture (4-6-50) combined with proper sanitation. Blue mold can be prevented by semi-weekly applications of spray solution applied as a fine fog under 125-lb. pressure beginning at least one week prior to the appearance of the disease and continuing until the middle of the planting season. The spray is made up of an emulsion of cotton seed oil, Lethane spreader, and red copper oxide. Benzol used as a gas either in the pan or the wick evaporators prevents or controls blue mold. Dichloracide as a crystal gas has been observed to control blue mold when used under a 64x64 mesh, wetted cotton cloth on four or more consecutive nights. Fertilizer treatments of tobacco seed beds have been observed to show the effect on blue mold development. Tobacco diseases are so destructive to the valuable tobacco industry in Maryland that the State is justified in spending considerable time and money in their control. Tobacco blue mold needs greatest consideration in this regard.

Apple Scab and Spray Injury.—The spraying of apples in Maryland seems to have begun in 1891, according to the Fourth Annual Report of the Maryland Experiment Station, and has been continued intermittently since that time. Work on this project dates back to 1929 when it was called "Apple Scab." Then, in 1936 the spray injury phase of it was added. This is in cooperation with the Departments of Entomology and Horticulture and is a part of the general project known as "Spray Injury Insect Control and Fruit Finish." The object of the project is to control the more important leaf and fruit diseases of apples by the use of fungicides without causing spray injury to either the fruits or leaves. A block of 700 trees on the Horticultural Farm, Beltsville, is being used to test the effectiveness of various new and old spray materials. The block has been broken up into smaller plots to receive the various combinations of spray materials. Included among these are Bordeaux mixture, lime sulfur 1-50, colloidal sulfur alone and in combination, and various substitute copper spray materials. Sprays are being applied according to the Maryland spray schedule and at a pressure of 450 pounds. The effect of these chemicals on the control of fruit and foliage diseases, and apparent injury to the same is recorded throughout the season, and a final evaluation is made on the harvested fruit from each plot. Sprays have been applied regularly as per schedule. Records have been taken on the prevalence of scab lesions of different treatments to determine the effectiveness of the various treatments and the distribution of scab lesions on the upper and lower surfaces of both the primary cluster and the later developing leaves. Records have been made on the spray injury of fruit and leaves at periods following each spray application. Preliminary observations indicate the following: that the various treatments produce a distinct difference in the prevalence of scab on the leaves; that some spray treatments under the conditions of the experiment are more toxic to foliage than others; that soil-cover and soil-treatment have an influence on the prevalence of scab on fruit and foliage; and, that contacts with commercial apple growers indicate a definite demand for information on the relative fungicidal values of the different spray materials and combinations used in the experiment.

Potato Seed Improvement and Disease Control.—This project was begun in 1932 in Worcester County and in 1935 it was extended to Garrett County. Experiments have also been conducted in Prince Georges, Howard and Washington Counties. The purpose of this project is to determine the best methods for maintaining vigorous seed stock which is practically free from diseases and mixtures. It also has for its objectives the determination of the best methods and the best materials for the control of potato diseases. The experimental plots are planted with different potato varieties and seedlings obtained from various sources and with home-grown seed treated in various ways. In Garrett County the experimental fields are planted in tuber units. Accurate records are kept on the prevalence of diseases, germination, stands and yields. The relative merits of various spray materials are also tested. The work has progressed far enough to permit the making of a number of new recommendations, many of which are already being adopted by progressive farmers. Spraying with Bordeaux mixture with the addition of insecticides for insect control has been found to be profitable on all potato crops grown in Maryland. Potato seed stocks of most potato varieties which are practically free from diseases can be maintained at least ten years and probably permanently in Maryland at elevations above 2,000 feet by the tuber unit method of planting combined with thorough roguing. Potato seed stocks grown in Maryland at elevations above 2,000 feet yield just as well or better than northern-grown seed stock. In Maryland potato seed stocks grown at lower elevations as a late crop yield just as well or better than seed stock grown at elevations above 2,000 feet or than northern-grown seed stock. In order to produce potato seed stock of most varieties which is practically free from diseases at low elevations in Maryland, it is necessary to renew the seed stock at least every other year. The maintenance of seed stock of the McCormick variety of potato, which is practically free from diseases, is so difficult that it is doubtful whether it can ever again be profitably grown as a commercial crop in Maryland. Late-grown potato seed stock of the Irish Cobbler variety can be made to come up just as early and yield just as well as northern seed stock and seed stock grown at higher elevations, if the storage temperature is raised to the proper degree after the rest period is over. The amount of disease present in the seed stock stored at low temperatures and that which was warmed up has remained practically the same. The treatment of spring-grown Irish Cobbler, Chippewa, Katahdin, Earlaine and Warba seed potatoes with sodium thiocyanate will shorten their rest period and make possible their use for the production of a late potato crop, but with the exception of the Warba variety stands will be poor and uneven and yields will be reduced. Fields in which the treated spring-grown seed is grown must be carefully rogued for the production of a late crop which is practically free from diseases. Experiments have shown the following varieties best adapted to Maryland conditions: early, Irish Cobbler and Warba; medium late, Green Mountain, Katahdin, and Chippewa; late, tidewater to 1,000 feet elevations, Dakota Red and Up-To-Date; above 1,000 feet elevations, Smooth Rural and Russet Rural.

Disease Resistance in Potatoes.—This project was begun in 1936. The work has been carried on at Oakland, Maryland. The purpose of the project it to find or produce varieties of potatoes which are either immune or resistant to vascular discoloration, late blight, scab and other serious potato diseases and which are adapted to Maryland conditions and suitable for market. Two acres of land were rented near Oakland, Maryland, in 1936 and the land was artificially inoculated with one of the organisms known to cause vascular discoloration. The organism was incubated ten days in barnyard manure which was spread on the field, and plowed and disked in. The field was planted to susceptible varieties which were not dug but allowed to remain in the soil with the hope that they would incubate the disease. Some wilt and vascular discoloration were present in the field in 1936 but not as much as was expected. In 1937, 743 seedling strains and varieties of potatoes were planted on the plot. Susceptible varieties were also planted throughout the field. These were dug and stored and in the spring they were examined for the presence of vascular discoloration. The amount found varied from none to 25 per cent. Ten per cent of the Mason variety, which was used as a check, had vascular discoloration. In the fall of 1937, a truck load of potato vines which had been rogued from a field on account of the presence of Fusarium wilt, one of the diseases which causes vascular discoloration, were spread over the test field at Oakland. They were plowed and disked into the soil. In 1938 the field was planted in four-piece tuber units with 826 seedling strains and varieties. The fact that a variation was found in the amount of vascular discoloration in the various seedling strains and varieties is an indication that resistance to this trouble is a variable factor. This indicates the possibility of finding or producing potato varieties which will be either immune or resistant to vascular discoloration.

Strawberry Root Diseases.—This project was begun in 1933. At present it seems as if at least two distinct root-rot diseases are prevalent, the Black Root-rot caused by a Fusarium and the Red Stele Root-rot caused by a Phytophthora. The latter is able to completely destroy strawberry plantings before the first crop of berries ripens. Attention is centered on the pathogenic organisms found in a strawberry roots with the purpose of developing methods of control including the breeding and selection of varieties resistant to the root diseases of strawberries. Field scouting has been done to study the prevalence, the symptoms and the losses caused by the Red Stele Root-rot. About 200 crosses have been made, using Red Heart and Aberdeen, two resistant varieties, and some of the most desirable commercial varieties. Sixty-nine named varieties and 31 seedling strains are now being tested for resistance to the Red Stele Root-rot in soil that was so badly infested with the causal parasite that an acre of plants produced only two crates of berries in 1937. There is a marked difference in the 178 plots set for resistance studies, but it is too early to say whether this difference is due to resistance to Red Stele or to some other factor such as hybrid vigor, or soil variability. There is no doubt about the seriousness of Red Stele Root-rot. It is a hazard of the fruit grower and the nurseryman alike. Approximately 40,000,000 strawberry plants were sold annually by Maryland growers. This is an important industry that is threatend by a single disease, but it can be saved by careful inspection and certification of plants grown for sale, by cooperation of the plant growers to prevent the marketing of diseased plants and by the rapid breeding of desirable resistant varieties to substitute for the susceptible varieties now grown. Enough work has been done already to indicate that resistant varieties of the various types will be produced within a reasonable time.

Disease Resistance in Peas.—This project was begun in 1936. It took over the intensive breeding stocks accumulated in the project entitled "Pea Root-Rots". The work has been done mainly at Silver Run, Oakland, and College Park, Md., and includes the breeding, selection and testing of peas for resistance to wilt (Fusarium orthoceras var. pisi), root-rot (Aphanomyces euteiches), powdery mildew (Erysiphe polygoni), blight (Mycosphaerella spp.), and unfavorable climatic conditions such as heat, drought and cold. Individual selection of the more desirable plants in wilt and root-rot infested soils, the elimination of the undesirable strains, and the crossing and back-crossing for new characteristics and types, has been the general practice. Nearly 1,000 crosses have been used, more than 10,000 individual selections have been made and tested as well as about 200 commercial varieties, many of which came from foreign countries. Several sweet varieties of canning type peas have been selected for uniformity of type, earliness of maturity, resistance to wilt and otherwise promising for Maryland conditions. These are being multiplied as rapidly as possible in Western Maryland and in Idaho. About 2,000 small plots of hybrid and pure-lined peas have been planted in Garrett County in 1938. The adoption by the canners, of Maryland Alaska 126 and H. F. 30, both introduced in 1936 has been encouraging. The H. F. 30 is two to three days later than Maryland Alaska 126. The two types of Alaska tend to extend the canning season by two or three days. This is a distinct advantage to the canner. About one-half of the pea seed planted in Maryland and considerable planted in other states came originally from the Maryland breeding plots.

Physiology of Plant Virus Diseases.—The project was started in the summer of 1937 to obtain further information on the nature of certain plant viruses and the physiological response of susceptible plants when infected with them. The results obtained to date cannot be used as a basis for final conclusions although they are highly suggestive. It has been found that under certain conditions the tissues of virus-diseased potato tubers yield extracts containing an abnormally high "peroxidase" activity. This been the case with leaf-roll, mild mosaic, spindle tuber, rugose mosaic, and what appears to be the "Y" virus disease. Fundamentally it is of interest to know the exact reasons for this increased "peroxidase" activity. From a practical standpoint the results suggest a rapid chemical means of tuber indexing for viroses. The method can probably be adapted to field inspections and building of foundation seed stocks. Previous workers have measured respiratory activity in small pieces of virus-diseased and healthy tissues. In the present study a technic has been developed for following, at least in part, the relative rates of oxidation in individual cells by measuring the rate of cyclosis. Application of very dilute sodium cyanide solutions produces a reversible inhibition in the rate of cytoplasmic streaming. By measuring the reduction in rate the relative activity of two oxidizing enzyme systems in the cell is obtained. One of these probably depends on an iron-carrying (cyanide inhibited) enzyme. The results so far show that at ordinary oxygen pressures there is little or no difference in behavior between apparently healthy, moderately mosaic-infected, and heavily mosaic-infected tobacco cells. Experiments are planned in which carbohydrate and oxygen supplies to the cell will be varied.

The Cytology of Some Pathological Responses Induced by Certain Chemicals.—This project was undertaken in 1937 to investigate the cellular changes resulting from application of certain chemicals to the tissues of higher plants. Because of its recent intensive use by plant breeders and experimental cytologists the alkaloid colchicine is being studied first. Preliminary studies have shown a marked similarity between certain aspects of cellular pathology in viroses of the mosaic type and colchicine induced injuries. In tobacco photochemical reactions seem to be related to colchicine toxicity. It is planned to investigate this phase of the problem more fully since no literature has been found on it, and the information is needed before other experimental work can be done.

Life History of Caryospora.—Since Caryospora putaminum is consistently found on old peach stones, an investigation of this fungus was proposed because of its connection with this important Maryland crop. While Caryospora is not known to be parasitic there is a possibility of a yet undiscovered imperfect stage causing a peach disease. As this Caryospora has one of the largest known fungus spores, it was thought that a cytological investigation would prove of value in understanding the life history of parasites. Single spore isolations have been made from perithecia collected in a number of Maryland orchards. The resulting isolants have been grown on various media and under varying conditions. Best growth occurred on a peach stone decoction agar kept at room temperature. Variation in the nutritive medium can cause great differences in the appearance of this fungus. Experiments in progress at the present time include the following: growth on varying carbon/nitrogen ratios, cytological studies on spore formation, storage of peach stones to determine their age when Caryospora invades them, regular collections of material in order to study spore formation in nature. The main accomplishments to date are as follows: the production of ascospores and perithecia on artificial media, the production of microconidia and spermagonia in culture, the isolation of a half smaller spored Caryospora, production of cultural differences by varying the source of nutriment. So far there is no indication of parasitism by the perfect stage and an imperfect stage has not yet been found.

Physiological and Biochemical Aspects of Vegetable Storage.—The physiological and biochemical aspects of the conservation of plant food products in storage and transportation has been an important field of research in this laboratory, extending over a number of years. This project has involved extensive studies of the "after harvest" physiology in a large number of vegetables and some cereals. Five station bulletins and four journal articles have been published to date, on this project. During the past year a dissertation on "A Comparative Study of Aerobic and Anaerobic Respiration in the Storage Organs of Different Plants," submitted by Doctor Russell Brown, a former graduate assistant, in the Experiment Station, has been thoroughly worked over and adapted for publication. Most of the text is now in final manuscript form. Some of the data were confirmed by additional experimental work. Doctor Parker just about completed an investigation on Hubbard squash before he resigned. We hope to complete this investigation in the near future.

A Physiological Study of the Resistance and Susceptibility of the Tomato Plant to Fusarium Wilt.—The work on this project has been published in Station Bulletin No. 374, under the title, "Physiological Study on the Pathogenicity of Fusarium Lysopersici Sacc. for the Tomato Plant". This work was done by Dr.

Paul L. Fisher, a previous assistant in the laboratory. The work on this project is considered completed.

Nitrogen Metabolism in Plants and the Relation of This Metabolism to Important Plant Responses.—Work under this project was suspended during the year because of personnel changes, but further work under the project is now in progress. The objective of the study is to determine nitrogen metabolism associated with certain plant responses such as photoperiodism, cold and drought hardiness, succulence, rest period, germination, and abnormal growth response such as spindling sprouts of the potato plant. The study to date has included a number of factors such as nitrogen metabolism during the major inflections of the curve for the "grand period" of growth; the modifying factors on nitrogen balance or ratio of the various nitrogen fractions as modified by low temperature during storage, high and low nitrogen fertilization, water content of tissues, and carbohydrate reserves. The study involves the determination of several forms of nitrogen that may exist in economic plants at various stages, and the effect of these conditions upon the plant itself.

Time Rate of Oxygen Respiration in Some Cereals in Relation to Total Natural and Imbibed Water and to the Ratio of Free and Bound Water.—The heating of grain is an important problem in its bulk storage. The respiration of the living kernels is the chief cause of the heating and the intensity of this vital process in turn is greatly modified by certain moisture conditions in the grain. The purpose of this investigation is to determine the time rate of oxygen respiration in wheat, corn, oats and rye in relation to the total natural and imbibed water, and in relation to the ratio of free and bound water. When the project is completed we should have accurate data on the whole problem of the water relation in cereals as they affect the respiratory intensity as measured by the oxygen absorbed. The preliminary work on the adaptation and use of the Warburg manometer and special respirometer for this study has been completed. This required a considerable amount of experimental testing, as this particular method and apparatus have not been previously used for respiration studies on cereals. The study of the effect on respiratory intensity of the changing percentage of natural water during ripening and maturing has been completed for wheat and corn, both sweet and field corn. All the experiments on this phase of the study have been repeated on crops grown in different years under different climatic conditions. So far the effect of imbibed water on oxygen respiration has been confined to some respiration tests on wheat that imbibed water from heavy dew while standing in the shock. Only preliminary work has been done on the relation of the ratio of free and bound water in cereals to oxygen respiration. This preliminary work has been done by a specially constructed dilatomer which measures the rate of hydration of the colloids in the endosperm. During the next year actual determinations will be made of bound water in order to determine the ratio of free and bound water under different conditions. Because of the rapid changes in relative percentages of the different carbohydrates in corn during ripening and under different storage conditions, considerable experimental work was completed on the correlation of different sugars to respiratory intensity of corn.

The Relation Between Vernalization and the Activity of Plant Growth Regulators, Flowering Substances, etc.—The theoretical basis of vernalization, the practical agricultural method of accelerating the development of plants, which enables us to understand the relation between the processes involved in this method and the activity of growth regulators, etc., has been studied during the previous year. The effect of the application of plant hormones at different stages of development is yet scarcely known. The purpose of the study is to secure the methods of developing the various stages of plant development at will with the aid of hormone treatments, and the understanding of the underlying principles. The investigations of the previous period have brought about many specific problems in two important phases of the problem of vernalization, namely, the transport of regulators and plastic substances and the reaction to them, and the chemical nature of growth substances and flowering substances. Field experiments have been started in collaboration with the Department of Agronomy. However, the general information thus obtained must be corroborated by greenhouse experiments. Experiments on treatments with growth regulators of plants grown in greenhouses have been carried out in collaboration with the Horticulture Department. The marker-method for registration of total growth, zonal growth, and size and velocity of curvature has been worked out further. The electric phenomena related to transport have now been recorded with a movie camera that has been adapted for this work. The shielding, however, is not yet very satisfactory. Experiments have been carried out on the following partial problems: determination of factors affecting the protoplasmic streaming, as the application of electric potentials; establishment of the relation between protoplasmic streaming transport; the interpretation of the electric phenomena observed during transport; transport measurements of different chemicals known as plant hormones, using velocity of root, leaf, and flower production on cuttings as a test; measurements of the concentration differences of growth regulators in different parts of the plant which are caused by differences in transport and lead to differences in flowering: after treatment of seeds, either with solutions or dust preparations of various growth regulators; after treatment of plants at different stages of development by means of spraying or application of dusts or pastes. A new group of growth substances, and the use of diatomaceous earth as a carrier for growth substances can be mentioned in this connection. Trends towards the following practical applications at the following stages of development have been revealed during the past year. In the treatment of seeds there is an increase in percentage of germination. Certain fungi and bacteria do not develop. If seedlings are treated there is a faster development, and damping off is decreased. Where adult plants are treated root formation is stimulated and bud development is regulated, and maturity is hastened.

ENTOMOLOGY

Biology and Control of Some Greenhouse Pests.—(1) The Biology and Control of Orchid Thrips, Physothrips xanthius Wms.—Studies under this sub-project have been in progress during the last year. The life history of the Orchid Thrips has been worked out, and the seasonal history is in process of being determined. Sprays have been tested, and it is indicated that pyrethrum is the most satisfactory material for the control of this insect without injury to plants or flowers. (2) The Palm Mealy Bug.—This investigation has been in progress for about six months, and some data has been accumulated in regard to the life history of the insect.

A Study of Laspeyresia molesta Busck in Maryland.—Two phases of this project are being investigated; namely, control of this pest by chemical means on quinces and a study of its parasitism in cooperation with the U. S. Department of Agriculture. During recent years a considerable number of parasites, furnished by the U. S. Department of Agriculture, have been liberated in the state. Annual surveys are conducted to determine what influence these parasites are exerting upon the pest. Some of these parasites are imported species, while others are native. To date the native species appear to be of more importance than the imported species in reducing oriental fruit moth population.

Investigations of Canning Crop Insects.—(1) The Biology and Control of the Mexican Bean Beetle.—This project was started in 1928 for the purpose of studying the habits and development of this insect and for the development of control measures. The

Clusters of Japanese beetles feeding on corn silks in the Cecil County field corn plots. Japanese beetles eat the silks as they grow, thus preventing complete pollination. In 1938 injury due to beetles was as high as 40 per cent of the potential yield.

so-called 20-20-60 or copper-lime-calcium arsenate dust was shortly developed, and magnesium arsenate was found to be satisfactory. However, these materials could not be used on snap beans near maturity, and pyrethrum was found to be valuable as a late spray. Later sprays and dusts containing rotenone were developed and found to be of superior value to other insecticides. In the course of this study life and seasonal studies have been made. Field tests are still being conducted with regard to the most satisfactory sources of rotenone. Ecological studies with regard to hibernation are also under way. No reports have been published on this work this year, but eight papers have been published during the course of the investigation. (2) Biology and Control of the Corn Earworm.—This project was begun in 1925 and has been carried on continuously since that time. Studies completed include seasonal history, habits and behavior of moths and larvae, egg-laying habits in relation to the corn plant, studies on hibernation in the field, and of certain control measures. Efforts to control the insect have included the use of attrahents, repellents, and insecticides, cultural practices, and observations have been made on natural control in the field. Varietal resistance of corn and ecological and physiological aspects of hibernation have also been studied. Laboratory experiments have also been carried on for the purpose of providing a better understanding of hibernation behavior. Three Station bulletins and four journal papers have appeared in regard to the work on this insect. (3) Biology and Control of the Pea Aphis.—This work was begun in 1921 and has continued intermittently ever since. The purpose of this project was primarily the development of satisfactory control measures. This has been accomplished to a large extent by the use of rotenone-containing sprays. Considerable investigation has yet to be done as to the efficiency of various sources of rotenone, the improvement of methods of application, and the relative efficiency of various wetting agents used as activators for the sprays. Observations on the yearly severity of aphid infestation are also needed. The use of dusts for pea aphid control is to be investigated during the coming year. So far, one Station bulletin and two journal articles have been published. Two reports on recent results are being prepared for publication.

Apple Insects.—(1) *Apple Plant Lice.*—During the spring of 1938 a series of tests were made on the comparative efficiency of tar oils and denitro-ortho-cyclo-hexylphenol against the overwintering eggs of the rosy aphids. One season's tests with these materials indicated little difference in the insecticidal efficiency of the two materials. The tar oils are rather disagreeable to work with in the orchard, and this condition is not met with when denitro-ortho-cyclo-hexylphenol is used in general orchard practices.

Factors Involved in Spray Injury Correlated with Insect and Disease Control and Physiological Effects.—This project has been in operation for two years in cooperation with the Departments of Horticulture and Plant Pathology. During the first two seasons, 1936 and 1937, the work was done in small, privately owned orchards; but for the 1938 season the work was transferred to a block of trees in the College orchard. The prolonged spray program necessary to keep apples free from insect and disease pests has resulted in considerable losses to orchardists from chemical and mechanical injuries to fruit and foliage. The work to date has concerned itself with a critical comparison of standard materials used by orchardists and newer insecticides and fungicides that have been developed and become available for experimentation. A great many factors are concerned that are difficult to evaluate. In general, two combinations, bordeaux mixture, lead arsenate and fish oil soap; and, wettable sulphur and lead arsenate, used during the summer season, have produced the best finish on fruits. The early season sprays, that is, those applied at the petal-fall and earlier, have been somewhat more variable in the action on the fruit.

Tobacco Insects.—(1) *Tobacco Hornworm.*—Seasonal and life history studies of the hornworm, particularly emergence of the adults, have been conducted by trapping records in three counties and general surveys of worm abundance in the tobacco-growing sections during the current year. No results have been published.

Ecological and Physiological Factors Concerned with the Hibernation of Insects.—This is a new project recently approved. New equipment for temperature control work has been installed. At present the Mexican bean beetle is being used for this study.

HOME ECONOMICS

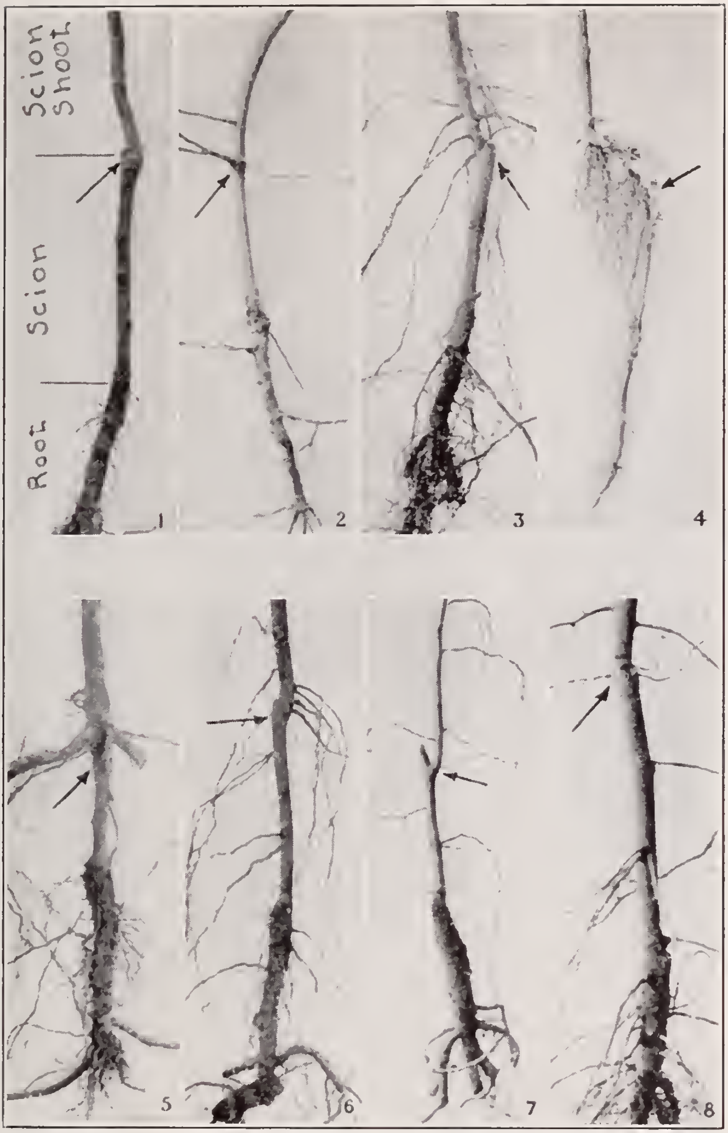
Standard of Living Study of Maryland Farm Families.—Seventy-two farm families in Carroll County, Maryland, were studied to determine as accurately as possible how the farm families used their incomes; to judge their standards of living, and to determine the adequacy of their diets according to accepted dietary standards. The information was obtained from schedules which were placed in the hands of the farm operators or homemakers. The investigator also held personal interviews with each family. From the schedules and interviews the data were compiled. Although there was considerable variation among the individual seventy-two families, the standards of living, on the whole, were high. In general all families consumed diets which were adequate in total calories, protein, minerals, and vitamins A and C. Among some families the diets were deficient in vitamins B and G as judged by accepted dietary standards. The report is available as Bulletin No. 422.

The Cooking Qualities of Canned Soybeans.—The purpose of this study was to determine the use of Rokusun soybeans packed in brine and processed for varying lengths of time; and the use of Rokusun soybeans packed in syrup and processed for varying lengths of time. These soybeans were canned by one of our State institutions and then sent to the University for developing recipes and determining their palatability as a food. Many palatable recipes were developed for the Rokusun soybean, copies of which may be had upon application.

A Study of the Performance During Wear of Women's and Children's Silk, Rayon, and Cotton Wearing Apparel Fabrics.— This study is carried on in cooperation with the textile and clothing workers in the Agricultural Experiment Stations of the Northeastern States. The purposes of the work are as follows: to determine the chief causes of non-durability in silk, rayon, cotton, wool, and linen textile fabrics used for wearing apparel by women and children; to obtain information which will be of value in formulation of consumer standards for wearing apparel fabrics of the types mentioned. Each student in the clothing classes who cooperated in the project bought an extra half-yard of material beyond what was needed for the construction of the garment. This extra material was sent to the regional testing laboratory where the following tests were made: thread count, initial breaking strength, initial bursting strength, resistance to abrasion, dry cleanability, washability, and colorfastness to water, to crocking, and to artificial acid and alkaline perspiration. Records, including wearability data, are being kept on each garment. Many of the materials which were sent to the testing laboratory were wool. These woolen fabrics had been sold to the students as having been sponged at the mill and that consequently very little shrinkage would occur in the cleaning of the fabric. The test showed that a large percentage of the woolens had shrunk during the dry cleanability test. However, those woolen fabrics carrying the Texturity Guild label did not exceed the standards prescribed by that label. The findings will not be completed until the wearing period of the dress has been determined. When the dress is no longer wearable, it will be sent to the regional testing laboratory located at the Pennsylvania State College, State College, Pennsylvania, for analysis.

HORTICULTURE

Fruit Spur and Biennial Bearing Studies of Apples.—This project, started in 1919, was designed to ascertain some practical means of changing the biennial bearing habit of apple varieties, as of York Imperial, and further, to determine the growth and nutritional conditions of the tree, and particularly the fruit spur, which might furnish a basis of explanation for the annual or biennial bearing habits of any given variety. To date field studies have shown that the biennial bearing habit cannot be changed by use of fertilizers, pruning, or cultural



Layered root grafts are a sure and quick means of propagating clonal apple stocks, replacing the slower and more expensive trench-layering. Clons vary in rooting ability from scions or scion shoots, as shown above. 1. Stayman. 2. Summer Rambo. 3. Pewaukee x Northern Spy. 4. Northern Spy. 5. U. S. D. A. 600. 6. Gleisberg's 13. G. *Long Ashton G8. 8. Ferman's Paragon.*

practices, although these practices are of value in maintaining annual bearing, once established. Heavy early thinning of fruits with trees in good vegetative vigor has resulted in annual bearing of biennial trees of Stayman and Jonathan. In spite of such growth conditions of non-bearing fruit spurs and terminals, usually associated with flower bud formation, heavy blossoming followed by heavy cropping in the on-year invariably resulted in no flower bud formation. Non-bearing spurs in the on-year were characterized by a high nitrogen content and low starch content compared with reverse conditions in the non-bearing spurs in the off-year. As a result of this work, it is recommended that fertilizers, pruning, and good soil management be used to assist in maintaining an annual bearing condition of apple trees, and in addition that thinning of fruits early be used to break the biennial bearing habit and to maintain the moderate cropping that is essential to annual bearing.

Sod Versus Tillage for Apple Orchards.—Started in 1920, this study involves field plots to compare several sod cultural systems with clean culture systems with and without cover crops for apple orchards; to determine whether apple trees can be maintained in a satisfactory fruiting condition under some system of sod culture; and to determine which cover crops and sod crops are more desirable for orchard use. Results have shown that apple trees can be maintained under sod conditions if sufficient nitrogen fertilizer is applied annually to the orchard. Young apple trees can be grown under sod conditions if a mulch is placed under the tree in addition to the use of fertilizer. Various sod crops, including alfalfa, sweet clover, ladino clover, and grass mixtures have proven satisfactory. The cultivation of apple orchards with or without cover crops has not maintained good growth and fruiting over a period of years without the use of fertilizer. Annual cover crops such as cowpeas, soybeans, millet, Sudan grass, rye, and vetch mixture, have been of great aid in controlling soil erosion, maintaining organic matter and tilth, and increasing the depth of the organic layer in the orchard soil. Growth of the young tree has been increased except when early seeding of cover crops (June 1) has resulted in competition between cover crop and the tree. Thus, early seeded cover crops and intercrops should be kept at a safe distance from the young tree, probably six feet, or the estimated root spread of the tree.

The Influence of Pollination on Fruit Yields.—In the planting of fruit trees or plants, the arrangement of varieties and to some extent the selection of varieties, depends upon the pollination requirements of the individual variety whether it be self-unfruitful or even self-fruitful. Since 1919 extensive work has been carried on with many apple and peach varieties in Maryland to determine the cross-compatibility of varieties and the many conditions which may affect the pollination and fertilization of the blossom. The Stayman apple variety was found to be self-unfruitful and would not set fruit when pollinated with pollen from varieties of the Winesap family, as Black Twig, Kinnaird, Paragon, and Winesap. However, Grimes and several other varieties were compatible with Stayman. Also, many Black Twig orchards were found to be unfruitful due to the inability of this variety to set fruit with its own pollen, but it was discovered that the pollen of Jonathan and Delicious varieties would give a satisfactory set. The Delicious variety also offered a problem, as a self-unfruitful variety, but several varieties were found to be compatible with Delicious. Golden Delicious and Starking also fall in the self-unfruitful class, but can be cross-pollinated with several varieties. The pollen of Delicious, Golden Delicious, and Starking is excellent to cross-pollinate other varieties. In any new planting of apples, it is recommended that the pollenizer be not more than two rows distant to obtain best results in cross-pollination under all seasonal conditions.

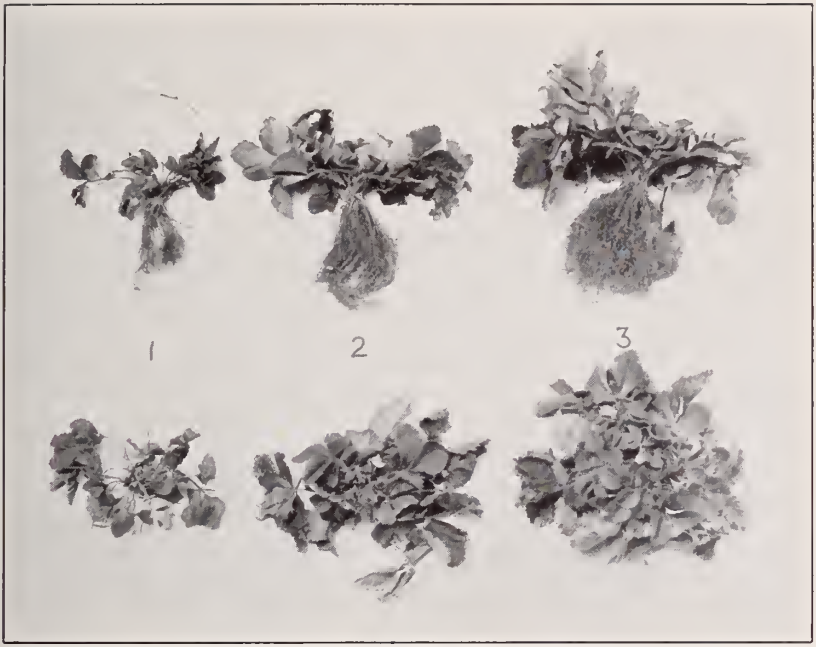
Experiments in Grape Training and Pruning.—Earlier work on this project resulted in the publication of Maryland Agricultural Experiment Station Bulletins 250 in 1922, and 286 in 1926. This project has had the general objective of improvement in the existing methods of pruning and training Concord grapes to obtain maximum annual yields of quality. Outstanding in the results has been the discovery of a pruning method that results in full bearing Concord vines in the third season after planting. The four-cane Kniffin system was found to be the best adapted to Maryland conditions, particularly as to yield and economy of vineyard handling. In some work on cluster thinning, a method of thinning off the undesirable clusters just before blossoming has resulted in larger, more compact bunches without appreciable reduction of yield and with some stimulation of vine growth. It is recommended that a medium length of cane about seven to nine feet in length before pruning, and of pencil-size in diameter be selected at pruning time for the fruiting cane.

Peach Pruning Experiments.—This work, started in 1924, has endeavored to improve existing peach pruning methods and to find methods of correcting the errors due to faulty pruning. Orchard plots have been laid out in several orchards over the state in cooperation with growers, involving varieties of Georgia Belle, Brackett, Shippers Late, Elberta, and Hiley. Four objectives have been definitely reached and put into practice by many growers as follows: lighter pruning of young trees has produced a larger fruiting capacity during the early bearing years and also has resulted in an earlier fruiting age (Md. Agr. Exp. Sta. Bul. 299); training of the tree in the first season by a new deshooting method has built a stronger framework of scaffold branches than usually develops; by means of a cutting back system, as opposed to heading back of one year wood, the correction of a dense growth of top on bearing trees has resulted in better fruit color and better quality of fruit; proper balance of cutting back and thinning cuts has resulted in the best fruiting behavior and annual maintenance of new fruiting wood without resorting to rejuvenation pruning at intervals.

The Breeding of Early Colored Grapes.—The actual breeding work was started in 1912 and many seedlings resulted from the work during 1912 to 1918. These seedlings have been under test under commercial vineyard conditions and selections have been propagated for further trial. One early ripening seedling looks promising.

Variety Tests of Apples, Peaches, Pears, Plums, and Cherries.—During the course of this work since 1890 several hundred varieties of tree fruits have been grown to determine their adaptability to Maryland conditions, particularly as to yield, growth, resistance to disease, hardiness, and quality. Present recommendations on varieties have been based to a large extent on the information secured from these plantings at College Park and in several places in the State. Among the newer varieties now under test, the Lodi apple appears promising as a variety to replace Yellow Transparent in the same season. Close, a new red apple in the Yellow Transparent season, introduced by the U. S. Department of Agriculture, also appears desirable for commercial planting in Maryland. Both Lodi and Close develop larger size than Yellow Transparent. Stanley, Hall, and Albion plums, introduced by the New York Geneva Station, fruited heavily in 1937, but the fruit ripened over a period of six weeks and dropped badly before reaching full maturity. Hence, these varieties offer to be of little value for Maryland. Among the newer peaches, Halehaven, Valiant, and Vedette, seem to possess sufficient merit under Maryland conditions to be worthy of trial in commercial plantings. All of these ripen about in the season of Hiley, but are all yellow freestone peaches of good quality. Vedette and Valiant set a heavy crop and must be thinned to obtain size of fruit.

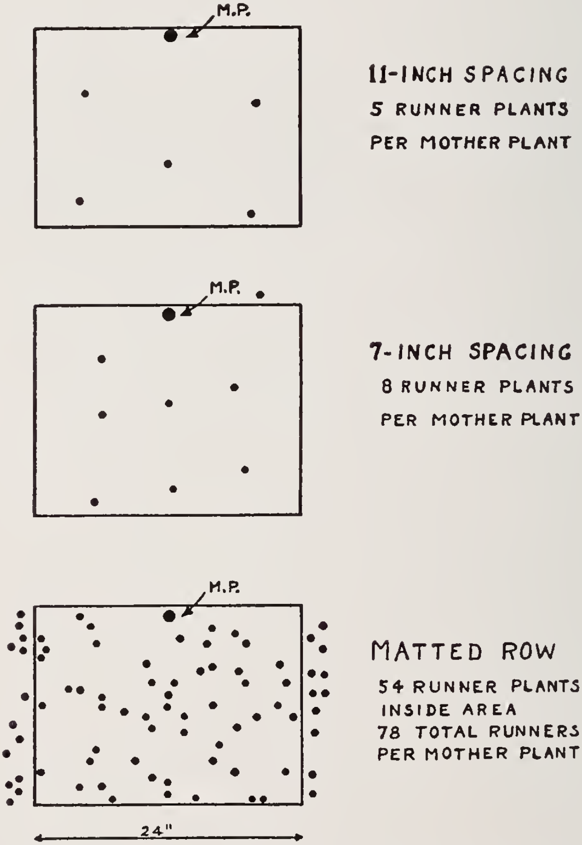
Variety Tests of Grapes and Strawberries.—Since 1890, numerous varieties have been grown under commercial conditions to test the merits of new varieties that have appeared.



Yields are increased by plant thinning of strawberries largely due to greatly increased size of plants, as shown by typical plants above. 1.—Usual matted row. 2.—Plants thinned to seven inches apart. 3.—Plants thinned to eleven inches apart.

In recent work on strawberries, the Fairfax and Dorsett varieties have shown excellent qualities and can be recommended. Blakemore, an early berry, develops an excess number of runners and hence needs plant thinning if marketable fruit size is to be obtained; also, rogueing of plants is necessary to eliminate the yellow-leaf disease in plantings. Among ever-bearing varieties, Mastodon far outyielded Gem and Wayzata in total marketable yield (spring and fall) but Gem and Wayzata produced a greater yield of fall berries of much superior color, flavor, and quality.

Variety Test of Bush Fruits.—At various intervals since 1890 plantings of raspberries, blackberries, gooseberries, and currants have been made to determine the merits of new varieties and their adaptability to Maryland conditions. A new planting was made in 1936 in Western Maryland in the center of the berry section to test new varieties of red raspberries, black raspberries, blackberries and Boysenberry. Records were secured in 1937 on yield, time of ripening, and size and quality of berries from the new planting. Additional observations were obtained relative to varietal differences in vegetative vigor, growth and fruiting habits, and the comparative resistance to anthracnose. Among the black raspberry varieties the Black Beauty, Quillen, and Bristol exceeded the Cumberland in yield, in the order named. In yield and vigor of plants, Black Beauty is outstanding, but the berries lack attractiveness because of an excess of grayish pubescence between the druplets. Bristol, Naples, and Quillen made a vigorous growth and showed excellent fruit characteristics with large-sized high quality berries. Naples was distinctly later in time of ripening and shows promise as a



Plant thinning of strawberries to increase yield requires great reduction in number of runner plants in the matted row, as shown by the actual spacing of Blakemore plants.

commercial late-ripening variety. Three sprays were applied last year for anthracnose control. Quillen, Bristol, and Naples showed considerably less anthracnose development than did the standard variety Cumberland, whereas Black Beauty, and the Logan particularly, showed susceptibility at least equal to Cumberland. Among the red raspberry varieties in the test, the Newburgh and Taylor were larger in berry and higher in quality than the standard variety, Latham, and ripened two to three days earlier. Both of these varieties, however, were injured by a killing back of the canes during the past winter. Evans and Dundee were added to the test planting this spring. The Marcy red variety was also added. It is planned to obtain yield records on all varieties this coming season. Further data relative to quality, disease resistance, etc., will also be obtained.

Collection of Phenological Data.—Each year since 1907 work on this project has endeavored to ascertain and record the seasonal conditions affecting the development of fruit plants and the fruit crops as well as essential data on freeze injury, time and period of blossoming, time of maturity, color development, and general growth of plants and fruits. Peach bloom in 1938 was heavy whereas the apple bloom was relatively light. However, considering the heavy crop of 1937 the apple bloom was satisfactory. On March 27, 1938, while most peach varieties were in bloom, the temperature dropped to 24° F. at the college orchard, which produced interesting results. Following this freeze, interesting varietal differences were evident since the temperature which prevailed was near the critical point of blossom injury. There was practically a 100 per cent kill of Elberta blossoms. Some of the newer varieties, Veteran, Vedette, Valiant, Oriole, and Sunbeam survived the frost with a good set of fruit. Only a small amount of damage to peach blossoms elsewhere in the state was reported. Early apple varieties were injured slightly by the freeze of March 27th. With the varieties, McIntosh, Lodi, Transparent, and Delicious, the terminal flower in the cluster was injured while most lateral flowers survived. A survey of relative blossoming and harvesting dates of apple varieties throughout the state indicates that with Grimes there is considerable variation in the number of days from bloom to harvest with this variety. On the other hand a large percentage of growers harvested this variety about 138 days after bloom. With Jonathan there was about the same variation in maturity but no concentration of picking at any time was apparent.

Apple Breeding and Testing of New Varieties.—In order to develop or discover new apple varieties more suitable than existing varieties in Maryland or varieties to supplement the commercial list breeding and testing work has been in progress since 1907. The early work attempted to breed an early red apple but none of the several hundred progeny proved of sufficient merit for introduction, although the work showed the value of Williams as a parent in such breeding work. In later breeding work varieties of high quality were crossed, trying to develop a fall or winter apple of high eating and keeping quality. Nearly 500 crosses are of fruiting age and the results of this work will be known after a few more years of selection and testing. In the testing of promising seedlings secured from other experimental stations, one apple has been found promising enough for naming and introduction. The seedling was originated by C. P. Close, as U. S. D. A. No. 57, and has been named the Close apple. The apple is an early red sort of large size, ripening at the time of Yellow Transparent or a day or two earlier. Good quality, earliness, large size of fruit, and vigorous growth of tree under Maryland conditions make this apple a desirable addition to our list.

An Economic Study of Peach Cling-Stone Varieties for Canning.—Anticipating the possibility that Maryland growers might wish or be forced to grow for the cannery rather than for the fresh market, the testing of cling-stone varieties used in California for canning was started in 1927 in plantings at College Park and at Salisbury through the cooperation of the W. F. Allen Company at the latter place. About 30 varieties have been under test but after several seasons of fruiting, not one of the varieties was found to be suited to eastern conditions. Failure to ripen, small size, poor quality, rough shape, and other defects were found among these varieties.

An Economic Study of Peach Planting Distances.—With the advent of larger peach trees of longer life resulting from the control of peach tree borers, greater use of fertilizers and change in pruning practice, it was apparent in 1927 that some change in the distance of planting would be necessary. Accordingly 1400 peach trees icluding three varieties, were planted near Colesville to compare the effect of planting distances such as 16′x20′, 20′x20′, 20′x24′, 24′x24′, with a filler tree in the center of the square set 24′x24′. The yield data show clearly the much greater yield per tree with greater tree spacing. The differences became much greater in the later years when trees 24′x24′ eventually were yielding twice as much as trees 20′x20′, or 24′x24′ with filler trees. Another point in favor of the greater spacing distances is found in the larger size fruits that were produced by the 24′x24′ trees with the 20′x24′ trees next best. Removal of filler trees helped the size of fruit in the 24′x24′ filler block. Tree size was affected by the spacing distances and is most easily shown by trunk size. At the end of the third growing season (fall, 1929) some small differences were shown in favor of greater planting distances. However, at the end of six growing seasons (1932) quite large differences were apparent. At the present time the trees with greater planting distances are much larger with greater bearing surface and more vigorous terminal growth.

A Study of Factors Influencing the Color on Apples.—With greater emphasis being placed on the red color of apples by consumers and by growers in meeting the U. S. Standards for better grades, it became apparent that much work was needed to determine the effect of various orchard practices on the development of red color as well as to determine ways and means of insuring the development of good red color under any seasonal or cultural conditions. Accordingly in 1927 many detailed experiments were started in orchards in Western Maryland, the results of which were published in Maryland Station Bulletin 353 in 1933. Fruit thinning, adequate moisture supply, adequate leaf area per fruit and proper light conditions were found to be the important factors to control in order to obtain development of a higher percentage of red color of high quality. In the present work about 100 red strains of several varieties are under study. Growers desiring to improve the coloring of apples must resort to fruit thinning, proper pruning, conservation of moisture or irrigation, and the planting of the red strains of the varieties desired.

A Study of the Effect of Nitrogenous Fertilizers on the Keeping and Shipping Qualities of Strawberries, Peaches and Apples.—The extensive use of nitrogen fertilizers on apple, peach, and strawberry plantings in recent years has resulted in questions as to the effects of fertilizers on the keeping and shipping quality of fruits. Some results from field and laboratory studies started in 1928 in Maryland have been published in Maryland Station Bulletins 366 and 326. During the past four years studies have been made of the various maturity indices in relation to the proper time for harvesting Grimes and Jonathan apples in order to secure the best edible and keeping qualities. These studies have included work with the pressure tester, electrical maturity tester, index number, color development studies, and studies concerned with chemical changes in the fruit, particularly as regards loss of starch as maturity approaches. Our studies have shown conclusively that the pressure test cannot be relied upon to furnish an accurate index of the proper stage of ripeness for picking. The so-called "index number" is derived from a mathematical computation which has as its basis the acidity of the fruit. It was devised by South Africa workers and has shown some promise as a guide to export maturity for certain of their varieties, including Jonathan. In our studies with Grimes and Jonathan, results very similar to those obtained by these workers have been secured, but the changes have not been sufficiently rapid as maturity approaches to make it "sensitive" enough to be of value as an accurate index. It holds very little promise for use in Maryland. Ground color studies with Grimes indicated conclusively that this is of very little value in determining picking maturity. Grimes from trees receiving good cultural care and fertilizer, and therefore in a fairly vigorous condition, change in ground color at too slow a rate during the critical period of maturity to be measurable by color charts under Maryland conditions. Red color changes in the Jonathan variety, however, were much more closely associated with the picking maturity of the fruit. These studies indicate that when at least 30 per cent of the surface of the average fruit on the tree is covered with red color before picking, good edible and keeping qualities develop. During the course of these investigations, various carbohydrate changes have been followed as the fruit matured with the hope that certain of these changes might be both sufficiently rapid and consistent to offer a reliable index to the physiological maturity of the fruit. Of these, starch loss as an index shows considerable promise with the Jonathan variety. The decrease is rapid, falling from better than 6 per cent to less than 1 per cent in the three weeks before harvest. Fruit harvested after the starch has decreased to less than 1 per cent has consistently developed fine, edible and keeping quality, whereas fruit harvested and placed in storage before this point has been reached has failed to develop these desirable qualities. In the case of Grimes, there is also a decrease in starch prior to harvest but it is not so great (at least 3 per cent starch, dry weight retained at time of commercial harvest) nor so rapid as with Jonathan and thus does not furnish as sensitive an index. It may be said that the observations (flesh firmness, ease of separation of fruit from spur, color, etc.) which have largely guided and composed the personal judgment of the grower in the past are still valuable aids in measuring the degree of maturity, and should not be entirely disregarded, particularly if the result is of honest observation and unbiased judgment.

Studies of the Effects of Different Nitrogen Fertilizers on Orchard Fruits.—In common with orchardists of other sections, the orchardist in Maryland finds it necessary to apply fertilizers annually to maintain the yields and growth of fruit trees at high levels. Questions as to the amounts of fertilizer to apply, the time of application, the kind of material, the method of application, and the relation of fertilizer use to other orchard practices and to fruit quality, have received attention in field studies in various orchards in the state through the cooperation of many growers with the investigators on our Station staff. One outstanding result of the fertilizer experiments has been the marked response of fruit trees to nitrogen and the frequent observation of deficiency symptoms from the lack of nitrogen, notably light green or yellow foliage, poor spur growth and terminal growth, and finally poor yields. Naturally fruit growers have turned to the extensive use of nitrogen materials, particularly nitrate of soda, sulfate of ammonia, and cyanamid. Other materials, including calcium nitrate, urea, calnitro, leunasalpeter, and calurea, have been under test in experiments. Results have shown that any of the nitrogen materials can be used with equal success in a maintenance program with trees in a vigorous, productive condition. With trees in a nitrogen-deficient condition, however, the use of a quickly available nitrogen material, as nitrate of soda, is essential at least in the first season. Other considerations modify the use of certain materials. For instance, cyanamid cannot be applied after the trees come into leaf without danger of leaf injury and defoliation. More slowly available materials, such as sulfate of ammonia and cyanamid, applied in large amounts in the early spring, have resulted in adverse effects on the ripening of the fruit in certain seasons, hence these materials should be used in the fall or in relatively small amounts if used in the spring. The amounts of nitrogen fertilizer to apply will depend upon the growth and fruiting condition of the trees on the one hand, and the soil fertility as a second consideration. Using a measured amount per tree which can be varied according to the tree size and vigor, the nitrogen fertilizer is spread by hand, broadcasted under the spread of the branches, including an area a few feet beyond the spread, and not including the area close to the trunk of the tree.

Removal of Spray Residue from Fruits and Vegetables.—With the establishment of spray residue tolerance for fruits and vegetables in recent years by the Food and Drug Administration, U. S. Department of Agriculture, Eastern growers, particularly apple growers, have faced the problem of spray residue removal. The problem involved such questions as washing versus brushing, kind of washing agent, temperature of washing medium, type of machine, and previous spray treatment. Since 1933, with the cooperation of the Bureau of Plant Industry, U. S. Department of Agriculture, experimental work on these questions has shown that the use of a hydrochloric acid wash at strengths of 0.5 to 1.5 per cent at room temperature have been sufficient to decrease the lead and arsenic residue below tolerance with apples receiving usual spray programs. With heavier residues, following the use of oil sprays, heating of the washing medium to 100° F. has been found necessary. The use of wetting agents added to the washing medium, has aided in the removal of residue. Both flood brush machines and flotation machines have been effective, with better efficiency with the flood brush machines. Use of dry brushing or wiping machines has not been found dependable. The present work is centered on varietal differences, seasonal differences, and the relative effectiveness of various wetting agents that appear desirable.

Relation of Soil Moisture, Age of Plants, Size of Plants, Spacing of Plants, and Use of Mineral Nutrients to Flower Differentiation, Fruit Yield and Quality of the Strawberry.—Earlier experimental work on the strawberry in Maryland was done largely on variety comparisons and on fertilizer trials. Some excellent results have been obtained on these points as published in Maryland Station bulletins. The present work, started in 1935, covers a wider field of study to obtain knowledge fundamental to the improvement of yield and quality of fruits under many conditions. Of particular importance for strawberry growers are the results obtained in thinning of runner plants (so-called plant spacing) which has given greatly increased yields, and better quality of berries (size and flavor) with several varieties including Blakemore, Catskill, Dorsett, Fairfax, Big Joe, and Premier. In this plant thinning, the early runners are allowed to set and are spaced by hand seven and eleven inches apart in matted rows so that the final number of plants per square foot is greatly reduced. All later runners were removed. In a dry season, as occurred in 1936, the plant thinning system showed to marked advantage with and without irrigation over the usual matted row system. Each runner plant under this system becomes much larger and apparently is more drought resistant. The studies include attempts to develop more practical ways of using plant thinning with our matted row system.

Factors Involved in Spray Injury.—The seriousness of spray injury to fruits, particularly apples, has been recognized by growers and the problem involves also the insect and disease control, likewise serious problems for the fruit grower. Therefore in this work, started in 1936, the Departments of Horticulture, Entomology, and Plant Pathology have taken up phases of the problem. In the horticultural work, one type of injury, namely skin-cracking of York Imperial apples has received most attention, and preliminary work shows that sprays aggravate the development of this injury, although trees and varieties vary in susceptibility and water relations, and weathering may be factors. Spray material apparently greatly aggravates a trouble to which York apples are susceptible. The degree of susceptibility may be related to soil moisture conditions and tree nutrition since some orchards have little or no trouble.

Plant Propagation with Special Reference to Cuttings.—Early work on this project dealt with attempts to propagate apple trees from stem cuttings. Many thousand cuttings have been placed under various treatments designed to induce rooting. A very few cuttings produced roots. In 1932 a method was reported by which apple shoots were etiolated with tape before the cutting was taken. Quite a number of such cuttings developed roots in the usual media, indicating this method as promising for experimental work on such material. In work on self-rooting (own-root development) of apple trees, several commercial varieties were propagated by the nurse-root method and thus induced to produce root systems of self-roots. Two hundred trees of Stayman and Arkansas with self-roots are now thirteen years of age, apparently maintaining vigor of growth and productiveness. More recently, in 1935, work on self-rooted trees of forty-five comestible varieties showed that many varieties produced root systems definitely characteristic in many respects for each variety. Thus it becomes important to know the root characteristics of varieties and wild apple species under several soil conditions in making clonal stock selections. Roots of French crab seedlings were very successfully propagated as root cuttings. It is suggested that roots be taken from the original tree of a variety, especially of new varieties that are introduced if root cuttings are to be used. A nurse-scion of French crab on a variety root assisted the variety root cutting to form new roots, indicating that the French crab furnished something to the variety. It was found also that roots of one year old seedlings of apple, peach, pear, and several other species propagated much more readily as root cuttings than did roots of two year seedlings or older material. Work with propagating media of sand and peat involved the use of forty-three species of fruits and ornamentals. Sand as a medium for cuttings resulted in the production of coarse, brittle roots. A mixture of sand and peat resulted in fine textured roots with thirty species. Of several factors studied, aeration and moisture were considered as affecting the type of root development. The exodermis was less developed in peat which may explain more lateral roots. In the propagation of fruit tree stocks from seeds, a study of the effect of drying before and following after-ripening of the seeds showed that drying before after-ripening had no effect on germination, but drying of the seed following after-ripening had serious effect in preventing germination. In studies of the factors affecting the vigor of the top growth on various stocks, it was found that the male parent of an apple seedling affects the vigor of a seedling and hence certain male parents should be avoided in gathering of domestic seeds. In 900 trees planted to test five different domestic seedlings with French crab, as used under four commercial apple varieties, there have been no measurable differences in growth and fruiting of trees on the several stocks after eight years. In the collection of wild species as promising sources of apple stock material, the identification of such species becomes important, especially when variations occur. A taxonomic study led to chromosome counts of eight indigenous species obtained from the wild and from aboretum conditions. It is hoped to find biotic types which will produce uniform seedlings. Recent studies on apple stocks also have led to methods of appraising apple clonal stock material in the nursery to determine quickly and more accurately the promising clons for further use. Propagation of fruit tree seeds necessitates care in regulation of moisture conditions of seed-bed. A mixture of sand and peat moss is a good medium for production of a fine, branched root system on cuttings of many species. Holly cuttings are best taken in September. Care should be used in selection of domestic apple seed for seedling production to avoid male parents, which give poor vigor of growth to the seedling. The layering of root-grafts offers a ready means for nurserymen to propagate clonal stocks, eliminating the trench-layering bed, otherwise necessary and expensive to maintain.

Sweet Pea Varieties and Novelties.—Conversations with growers and articles in periodicals, often mention that a certain variety of sweet peas has gone out of use because it was "no good." It would seem that more specific reasons are desirable to determine the cause of these failures, but a survey of the commercial kinds is the first essential. "Sonnet," is a light pink, too light for home use, and looks faded as soon as picked. "Star" is a dark pink, fine color and holds up well. The buds drop badly. "Sunproof Orange" is scarlet in color and does not burn when bright sun is experienced for several days, and has slight bud dropping; has only medium vigor and short stem. "Josie" is very vigorous grower, pink lavender in color, has better stems, does not drop buds as badly as "Star", but the color is less pleasing. Several English varieties of carnations are being distributed by a New Jersey firm of florists. They have been said by many to be unsatisfactory. Three varieties were secured and planted on a bench following winter flowering snapdragons. Two of the varieties grew as normally as the American kind, but the other one grew poorly. To date the poorest growing of the three, called "Purity", with long, slender stems, with heavy white flowers, has produced two blooms per plant. "Claret", a deep maroon, with strong shoot stems, has produced five blooms per plant, and "Pelargorium" red variety, with each petal edged with pink, narrow grass-like foliage, has given four blooms per plant. "Patricia", a large white, striped with pink, of American origin, has produced eight blooms per plant, and "Pink Abundance", another American variety, has made ten blooms per plant.

Breeding and Selection of Snapdragons.—Disease resistant, winter-blooming types with desirable color of flowers and tough, wiry stems are desired by florists. There are many varieties of suitable colors and habits of growth, but many of them are not resistant to disease, especially rust. Since 1922 a number of varieties have been crossed in breeding for the special characters needed. Some of the crosses have shown excellent qualities both in the first and second generations. A white variety has been segregated, which thus far has been immune to rust. This is being crossed with various colors with the hope of getting a variety of plants in several colors, immune to rust.

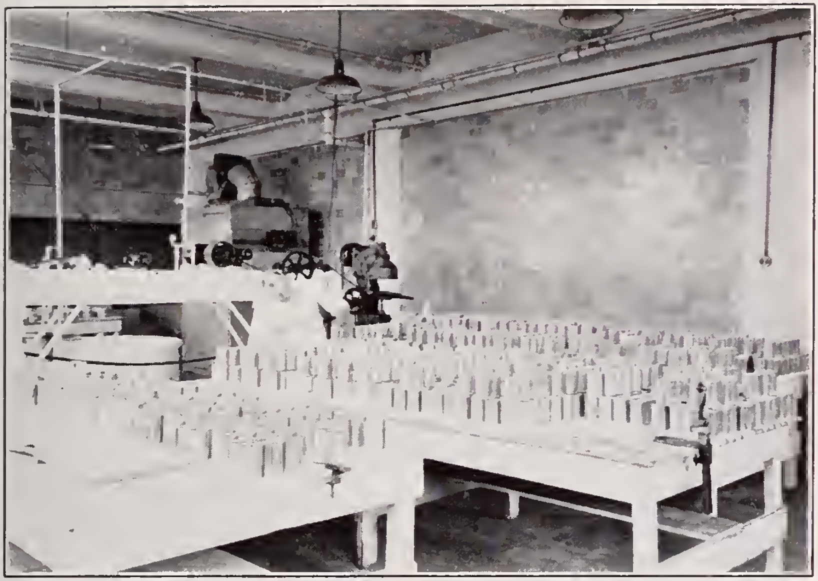
Testing of Winter-Blooming Varieties of Gladiolus.—Florists have been unable to get gladiolus to bloom in greenhouses if they are planted before February 1st. Lengthening the daily period of light by use of artificial light thus producing the so-called long day has brought all varieties into bloom in winter, but this method is expensive. A strain from Holland, called the Herald Strain, produced bloom in March following fall planting.

Treatment of Greenhouse Soils.—The changing of soil in greenhouses entails considerable labor and expense, and florists located in large cities have difficulty in securing new supplies. Hence, since 1922, in this project methods have been tried to allow continuous production of flower crops in green houses without taking out or changing the soil. The most noticeable difference in the physical character of the greenhouse soil, compared with that outside, is the absence of any tendency of the greenhouse soils to form a crust or layer of dried silt over the surface. This condition is changed somewhat if the soil is steam sterilized. When using soils not sterilized the soil is firmly packed after plants are set. Under outside conditions the garden is subject to much leaching or diluting of the soil salts during heavy rains. Heavy watering has been found very beneficial in the greenhouse. Beds covered with straw and occasionally watered during the inactive period of the summer months may be planted in the fall and a good crop secured of any of the annual plants grown in the greenhouse. When the soils dry out during the summer time, soil borne diseases assume a resting stage and become virulent when the soils are moistened for setting a crop. If the soils are kept moist through the summer resting stage, the organisms become weakened or destroyed. Some straw covering, which is raked off clean before the bed is spaded for the new crop, checks evaporation and saves the water. A plot of soil carried in the greenhouse since 1898, or forty years, still grows good crops of calendulas, snapdragons, etc. It is six inches of soil underlaid with six inches of cinders. An annual steam sterilization of the bed results in good crops of chrysanthemums and sweet peas. Double digging, or bringing the lower six inches of the soil to the surface is found to be a good practice.

Factors Influencing the Yield and Quality of Garden and Canning Peas.—The results of earlier work started in 1922 have been published in Maryland Station Bulletin 306. The improvement of yield and quality of peas in Maryland has presented an important problem for growers and canners and has called for both field and laboratory studies on the effects of various practices, such as fertilizing, liming, rotations, rate of seeding, depth of seeding, time of seeding, etc. The problem of methods of grading raw peas to predict the quality of the canned product likewise is closely related in evaluating the effects of various factors affecting quality. The early studies with fertilizers have shown the beneficial effects of fertilizers high in nitrogen. In recent years the use of calcium cyanamid to counteract the effect of pea root-rot has indicated considerable value in increased yields. In continuance of the work on grading peas started in 1935, extensive work was conducted in 1936 and 1937. In the work with sweet peas, flotations were made in 7%, 10%, and 13% brines, each of which in addition to composite samples, were canned separately for grading. One hundred and two lots of sweet peas of the Perfection variety were handled in this way, with a total of five hundred and ten different canned samples. While there is not complete agreement between the actual and predicted grades, it was possible to predict the grade either exactly or to be one point off, or not more than two points off, 85 per cent of the time. Probably the most accurate formula for evaluating quality in 1938, would be one having values midway between those of 1936 and 1937. This would be as follows:

$$20.92 + .06\ (A) + .055\ (B) + .03\ (C) = \text{Grade.}$$

By the 1937 formula for Alaska peas it was possible to predict the grade exactly or to be one point off, or not more than two points off from the actual grades of the canned samples, 94 per cent of the time. The tenderometer, a machine which measures the shearing force required to press a sample of peas between two grids was used on a number of samples. A method was devised for converting these pressure readings into grade values. These grade values when compared with actual grades of canned samples of the same lots of peas, gave the greatest degree of



The development of a method of predicting grades of canned peas required voluminous data on raw stock and many cans of peas.

accuracy of any method used in these studies. Comparison with actual grades shows that it is possible with the tenderometer to be exactly the same, or one point off or not more than two points off 93.5 per cent of the time. The results commend the use of this machine. Averages of random samples and of daily deliveries agree very closely both in the case of formula predictions and tenderometer results. Both methods are sufficiently rapid to be practical for cannery use and the procedure is entirely mechanical in each case, thus eliminating any variability in personal judgment.

Factors Affecting Growth of Rhubarb.—Started in 1921, this work has attempted to solve the problem of growing rhubarb without manure and to prevent crown root-rot. High losses are encountered each year by a crown or root-rot. Good results have been obtained by using commercial fertilizers high in nitrogen. Sulfate of ammonia gave best response compared with other nitrogen fertilizers. Since root-rot seemed to be aggravated by water standing in the low places, it was thought that plants grown on ridges would keep the water drained away from the crowns and thus make conditions more favorable. At present the plants set on the ridges are more vigorous, have larger stems and leaves than those planted flat.

Breeding and Selection of Cantaloupes.—Improvements of cantaloupe varieties for better adaptation to cantaloupe sections of Maryland has been a problem for many years. Breeding work has been in progress since 1912. One effort to produce a green-fleshed melon with thicker flesh has resulted in some promising selections. The cross between Jasper with other green fleshed, but thick-meated types, similar to Honey Dew, resulted in large, early melons of fine quality and disease resistant. Selections have been made of the promising types and these, now of the third generation will be grown, one individual to the row, for further selection.

Cultural Factors Affecting Production of Sweet Potatoes.—Sweet potatoes are affected by environmental conditions in the production of commercially desirable size. Observations indicate that sweet potatoes on soils high in organic matter produce only one or two very large roots to the hill. Some preliminary work indicates that a late application of fertilizer may affect storage root initiation. Work on this project was started in 1912. Recent work with fertilizers included applications at various periods and placement at various distances from the plant. The indications regarding the nitrogen application, when three or twelve inches to the side, were in favor of the three inches and a larger yield was secured when the application of the fertilizer was delayed from one to four weeks. The work on the application of the fertilizers at the time of planting or deferred one to four weeks will be repeated this season. Another experiment in which the runners were taken off the sweet potato plants until the eighth week, resulted in a much reduced yield. There were indications that rotted manure increased fibrous roots.

Maintaining the Fertility of the Land for Garden Crops.—This project was started in 1915 to determine if fertility of land for garden crops could be maintained without the use of manure. Results published in 1929 in Maryland Bulletin 309, obtained from the field experiments from 1915 to 1927, are summarized as follows: "These results emphasize quite strongly that under the conditions of this experiment, (1) commercial fertilizer maintains yields as well as light to medium applications of manure, and (2) light applications of manure plus fertilizer, are quite as effective as medium applications of manure alone, or of fairly heavy applications of fertilizer alone." Recent work on a sandy loam of low native fertility has shown that 1,000 pounds of 6-6-5 per acre will grow fair crops of tomatoes, melons, sugar corn, sweet potatoes, etc. and that addition of soybean tops grown on other land gave better yields, especially when sugar corn and cabbage were grown.

Cultural and Fertility Studies with Asparagus.—The asparagus crop is becoming more important to canners as well as truck crop growers. To develop methods of production to obtain large yields of good quality presents a problem of prime importance if profitable crops are to be grown. Since 1917 work on fertilizers and distance of planting has given some results of value. Inorganic fertilizers, such as 6-6-5, at the rate of 1,000 pounds per acre have kept the asparagus plant in good vigorous and productive condition with no organic matter added. It would seem that asparagus is well adapted to the light soils of the Eastern Shore. The bed at the Ridgely Station has been in production for ten years. All tops, weeds, etc. are mowed off and burned annually, so that very little organic matter other than the decay of the old roots is supplied. The plots upon which the plants were set, 48x20 inches apart, are yielding most stalks, and the home mixture of 400 pounds of nitrate of soda, 200 pounds of superphosphate, and 400 pounds of kainit are producing more than the commercial trials, 6-6-5 and 4-8-4, at the rate of 1,000 pounds per acre. The bed is producing around four tons per acre annually.

Breeding and Selection of Tomato Varieties for Canning.—New varieties of better quality and yield are constantly demanded by canners and growers of tomatoes. For several years work has been in progress in breeding and selection. Naturally, new varieties must be tested over a period of years before the merits can be ascertained, so no introductions have been made from selections to date. Specific desired improvements in the present tomato varieties include better shape, higher yield, resistance to weather and diseases, resistance to cracking, and more solid flesh. Selections were made last year from the cross of Marglobe by Browns Special, Italian by Break O'Day, and also the resistant type sent out by the Waltham, Massachusetts, Station again crossed by Marglobe. A French variety which has no abscission layer on the stalk above the fruit has been crossed and the second generation sown. The fruit leaves the stem readily and stalk and calyx is left on the plant. If this feature can be transferred to the large canning varieties, it should be valuable in avoiding the puncturing of ripe fruit by the stems in the baskets after picking.

The Influence of Green Manures Supplemented by Commercial Fertilizers in Tomato Production.—These field studies, started in 1930, resulted from a need to find a substitute for stable manure which is no longer available to the extent formerly used in tomato production. The plowing under of green manure crops, supplemented by sufficient commercial fertilizers seemed to offer a means of solving the problem. Results to date on sandy loam soils of low native fertility have not shown that green manures can replace stable manure in tomato production. In a five year experiment at College Park results were as follows: (1) no appreciable difference in yields between green manure plots and those not planted to green manures; (2) addition of barnyard manure continues to give relatively high yields, particularly of tomatoes; (3) no significant nor consistent differences between 6-6-5 and 4-8-5 fertilizer plots are seen; (4) check plots produce extremely low yields, with the exception of the corn crop, which seems better able to produce a crop under conditions of low soil fertility.

Breeding and Selection of a Fruitful Type of Lima Bean for Maryland.—The production of lima beans for the fresh market is an important part of the truck crop industry in Maryland and many other regions south of this state. In Maryland some 1,500 to 2,000 acres are planted to market lima beans while a somewhat greater acreage is planted for canning. The large podded variety, Fordhook, is widely planted and in the past years has been established as the standard market type. From the point of view of the consumer, the variety is satisfactory, but from the grower's point of view this is not the case, since it has proved to be wholly unreliable as regards pod set, when grown in Maryland and other regions subject to similar climatic conditions.

Potato Breeding and Inheritance.—One specific need for Maryland farmers is a better late potato than Jersey Red Skin. Breeding work since 1932 has produced some promising progenies that will be considered in further studies. No new varieties are ready for introduction. As an aid to potato breeding work, germination studies on freshly harvested potato seeds (normally showing delayed germination) has resulted in discovery of the following knowledge of potato seed germination: seeds from fruits stored at 23°C. for thirty-five days after harvest germinated significantly faster than seeds from similar seed balls stored at 0 to 5°C. during the same period; the following treatments produced no effect upon the rate of germination of new seed: (1) immersion for one hour in 5, 10, 25 and 50 per cent ethyl alcohol, (2) immersion for twelve hours in 6 per cent ethylene chlorohydrin, and (3) immersion for 45 minutes in 2, 5, 10 and 25 per cent sulfuric acid; when the seeds did not decay, treatment with concentrated sulfuric acid for thirty seconds to one minute increased the rate of germination of new seeds; there was no difference in the rate of germination of dried and non-dried seeds; both old seeds and twenty-five day old seeds were very resistant to dessication and gave 93 to 96 per cent germination after drying to constant weight at 72°C. The heat and drying did not change the rate of germination. There was no difference in the rate and amount of water intake of seeds twenty-five days old and seeds one year old or older. Removal of the tissue around the radicle and exposing it in a naked condition caused the germination of seeds which normally would not germinate. Removal of the seed coat caused an increase in rate of germination but the effect was attributed to puncture of the nucellar tissue upon removal of testa. The results of the treatments indicate that the mechanism causing delayed germination is probably exclusion of oxygen by the nucellar membrane. The embryos of the potato seeds used in these experiments were capable of growth immediately after the fruits were harvested and, therefore, were not dormant.

A Study of the Regional Adaptation of Certain Vegetable Crops and Varieties in Maryland.—New varieties of vegetables are created each year and it is desirable to know the characteristics and adaptation of these varieties under Maryland conditions before growers make extensive plantings of undesirable varieties. Starting in 1936, variety comparisons have been made near Salisbury and Oakland with only those varieties which show outstanding promise. At Oakland several cool-season crops such as Brussels sprouts, cauliflower, lettuce, and celery, showed adaptability for this section of the state. Among the new varieties of vegetables that show promise for the Eastern Shore trucking areas are: Glovel tomato, Early Baltimore tomato, Early Giant Lima bean, Asgrow Stringless Greenpod snap bean, Colorado cucumber, Kleckley No. 6 watermelon, a wilt resistant strain, and Marglobe Golden sweet potato, developed and introduced by the Maryland Station. New varieties must be tested over several seasons to get the effect of seasonal conditions.

The Effect of Certain Factors on the Growth of Tomato Plants and the Quality of the Fruit.—To make a more complete analysis of problems in tomato culture, these experiments, started in 1937, include studies of vernalization, date of planting, defoliation of plants, methods of measuring fruit quality, and the effect of temperature, light, humidity, soil moisture, and rainfall on fruit setting, yield, fruit quality, and fruit cracking. In the work in 1937 some interesting results were obtained from plantings made May 8th, May 21st, June 7th, June 20th and July 15th. From the data obtained it was found that tomato plants planted in the field on May 8th and May 21st produced a greater total dry weight per plant and a higher yield of ripe fruit than any of the later plantings. There was no difference in fruit yield from the plants in the first and second plantings, but the planting on May 21st (second planting) produced plants with a greater total dry weight, larger leaves, and a greater number of clusters per plant in a given period after planting. Defoliation began in 65 to 80 days after planting in all plantings, and at the end of the season the apparent defoliation was greatest on plants in the first planting and progressively less with each successive planting. However, on the basis of percentage of leaves that abscissed, the defoliation at the end of the season was greatest on the second planting. Leaf size was significantly smaller throughout the season on plants in the last three plantings. The average number of blossoms per cluster was about five in all plantings. The percentage of blossoms developing mature fruits varied from 40 per cent on plants in the fourth date planting to 49 per cent in the first planting. The number of days from anthesis to the pink stage of the fruit was 41 to 42 days in the first, second, and fourth plantings. On plants in the third planting it took only 32 days from anthesis to pink fruit. The more rapid development in the third planting was attributed to higher mean temperature during the period of fruit development.

POULTRY

The provision of funds for a Poultry Plant and Poultry Building by the State Legislature and the very generous gift to the University of Spring Hills Farm by Mr. Charles McManus will enable the poultry staff to conduct more, and more valuable research with poultry. More viable, more efficient and more productive strains of poultry which produce meat and eggs of finer quality will be sought through research in breeding, feeding, physiology and management. Maryland poultrymen must be enabled to recapture their home markets for chicks, eggs and poultry meat and to compete successfully in markets outside the State. Maryland consumers must be offered Maryland poultry products in adequate volume and of assured quality or superior to similar products from any other source. Efficient poultry of good quality will enable the poultryman to sell his products profitably at prices the consumer can afford to pay. Five major projects comprise the research program set up to accomplish these objectives.

Physiology and Reproduction of Poultry.—Knowledge of the causes and controlling mechanisms of egg laying, rate of egg production, molt, broodiness and fertility will be sought. Such knowledge will make possible better control and more efficient and economical production of eggs. It is known that illumination, temperature, hormones and nervous stimuli affect reproduction. The period of illumination is known to determine seasonal rate of egg production. Studies of the effects of period of illumination on molt and broodiness have been started.

Supplementary light increases fall egg production by old hens. The hens on the right were given a fifteen-hour day from July 1. The pen on the left received only the normal daylight period. The lighted birds averaged thirteen eggs each during October while the unlighted birds averaged only six. It would frequently pay a poultryman with a flock of 200 or more birds to cull his laying flock the latter part of June, and after marketing the poor producers, put the others under artificial lights so that they will have about fifteen hours of light daily.

Factors Affecting Quality of Poultry Products.—Research on the effects of genetic constitution, methods of handling, transportation and marketing on egg quality will be undertaken. Better methods of determining interior quality of eggs and of assuring the consumer that he is getting the quality of product he pays for will be studied. There is a place in the human dietary for all wholesome poultry meat and eggs. Research will be conducted to raise the general quality but especially on means of identifying quality so that products of different quality may be directed to their proper use. Research on the effect of a brief period of heating on egg quality has been done during the current year in cooperation with the International Baby Chick Association. It was found that 14 hours at incubation temperature causes about the same deterioration as four days at a temperature of 65° to 70° F. This problem is of importance to commercial hatcheries since it is possible to remove and sell infertile eggs after 14 hours incubation. Such eggs are quite wholesome and edible but inferior in quality to fresh eggs.

The Efficiency of Poultry in the Utilization of Feed.—Leghorns will be progeny tested for their efficiency in converting feed into eggs. Barred Rocks and Rock-Red crossbreds will be progeny tested for ability to convert feed into flesh as broilers. Turkeys will be progeny tested for ability to convert feed into flesh. Strains of chickens and turkeys with high feed efficiency will be developed for testing under practical farm conditions.

Nutritive Requirements of Poultry.—More efficient and more economical feeds will be sought for poultry. Emphasis will be placed on locally grown and locally processed feeds.

Viability of Maryland Poultry.—A program of progeny testing and management will be carried on to further increase the resistance to pullorum disease of the Single Comb Rhode Island Red Strain developed at the station and to develop other strains of high viability in general. There are so many diseases that cause loss to the poultrymen that it seems likely that mortality may be reduced by breeding strains of high general vigor more quickly than to combine genetic resistance to many diseases in the same strain. The breeding of strains resistant to many diseases is, of course, an ultimate goal of great importance.

A Controlled Test to Determine the Efficiency of Approved Good Management in the Control of Bacillary White Diarrhea.—A breeding flock of Single Comb Rhode Island Red chickens shown, by their reaction to usual tests, to be infected with Pullorum disease, was established at the Maryland Station in 1926. Descendants of this original flock have been selected in part on a basis of progeny resistance to natural infection with Pullorum, for twelve years. Mortality due to Pullorum among the chicks has decreased from an initial value of 50 per cent to a value of less than 5 per cent during the current season. Infected birds were included in the breeding flock at all times. Tests made during the current year indicate that chicks of this strain are more resistant to infection with Pullorum disease than Single Comb Rhode Island Red chicks from a flock in which there has been no infection with Pullorum during the past fourteen years. Further research is essential to determine whether the presence of a low incidence of Pullorum in each generation is conducive to the maintenance of resistance to Pullorum disease. It may be possible to develop and maintain resistant strains, free of Pullorum infection. Birds will be progeny tested for resistance to artificial infection with Pullorum. Non-infected sibs from resistant progenies will be used as breeding stock. This project will become a part of the project entitled "Viability of Maryland Poultry."

Factors Affecting the Food Value of Eggs Both Fresh and in Storage.—Eggs are very valuable protective foods in the human dietary, comparing favorably with milk in this respect. The vitamin A (essential to normal vision, reproduction and growth) content of eggs is of special importance. Research conducted in cooperation with the Department of Chemistry indicates that eggs from Barred Plymouth Rocks (brown shelled eggs) are equally as potent in vitamin A as eggs from Single Comb White Leghorns (white shelled eggs). This project will be replaced by research conducted under projects entitled, "Factors Affecting Quality of Poultry Products," and "Nutritive Requirements of Poultry."

SEED INSPECTION

Inspection of Seed Sold Throughout the State.—This work has been carried on continuously since early in 1913. Its purpose is to see that seeds offered for sale are tagged as required by State law. Retail stores, railroad stations, steamboat wharves, and other places where seeds may be found in storage or in transit, are visited, often several times a year, and the tagging of each lot found is inspected. Only a very small percentage of the lots of seed now passing through commercial channels is untagged.

Examination of Samples from Seeds Sold Throughout the State.—Samples drawn from lots of seed which are inspected each year are examined in the laboratory to determine the accuracy of their tagging. The kind of seed, the percentage of the bulk that is pure seed (seed of the kind specified), the percentage of the bulk which is weed seeds, the number and kinds of noxious weed seeds per unit weight of the bulk, and the percentage of the pure seed that germinates (the percentage that can reasonably be expected to produce normal plants under favorable conditions in the soil), are determined for each sample. The result of each examination is reported to the retail dealer (or the consignee, if the sample was taken from a lot in transit), and to the wholesale dealer who tagged the lot of seed. This work is summarized each year to show the completeness and the accuracy of the required tagging information of the samples of each wholesale dealer. On the basis of these samples, each wholesale dealer is given a rating (Tagging Reliability Index) each year. In 1937 there were six wholesale dealers with ten or more samples. The Tagging Reliabilty Indices of these six wholesale dealers ranged from 36 to 85. With this information available, sufficiently interested purchasers of seeds can avoid buying seeds from firms whose samples are incompletely and inaccurately tagged.

Examination of Samples Submitted to the Laboratory.—Since the establishment of the Seed Laboratory in 1912 it has been the aim of those responsible for the work to give the seed user whatever information may be needed by him for judging whether a lot of seeds will be suitable for the purpose for which it is wanted. In so far as facilities permit, information is furnished regarding all the characteristics which affect the planting value of lots of seed. This information covers such items as (1) identity of the pure seed, (2) noxious weed seed content of the bulk, (3) sanitary condition of the bulk, (4) mechanical composition of the bulk, (5) germination response of pure seed, (6) size of the pure seed, (7) plant producing capacity of the bulk, and (8) other characteristics which are less generally of significance. The steady increase in the number of samples submitted to the Laboratory is evidence of the appreciation of the value of such information.

Studies of Observed Variations Among Germination Tests.—Because of the relatively small number of seed employed and variations among environmental conditions, replicate germination tests do not give identical results. In order to determine what range of variations may be expected with different kinds of seeds, data of large numbers of tests are being assembled. A statistical study of these data will indicate what "normal" variation is for different kinds of seeds.

Studies of Weight Changes of Components of Seed Samples and the Resulting Effects upon Percentage Composition.—When working samples used for mechanical composition analyses are subjected to changing atmospheric conditions changes in weights of the different components are not proportional. The amplitudes of these disproportionate changes are being studied in order to determine the effects upon percentages of different components when mechanical composition analyses are made under different atmospheric conditions.

Economic Use of Seeds.—Due to variations among the percentage of pure seed, the percentage of plant producing seeds, and the size of the pure seed, the number of plant producing seed per gram of 653 red clover seed samples were found to vary from 106 to 843. If a uniform seeding rate (for example, one of 10 pounds of seed per acre) had been employed with this group of seeds, the number of plant producing seed that would have been applied per unit area of ground planted would have varied (inversely) over the same range, that is from 106 to 843. Obviously, such a group of seeds could be economically planted only by adjusting the seeding rate of each lot to its plant producing capacity.

The Bulletins Named Below Are Available for Distribution.

These Bulletins are sent free of charge to any address upon application.

EXPERIMENT STATION BULLETINS

Bulletin No.	297, July, 1928,	Environmental Factors Influencing Wheat Production.
‘‘ ‘‘	312, July, 1929,	Variety Studies of Spinach.
‘‘ ‘‘	314, Aug., 1929,	Culture Experiments on Fertilizing Asparagus.
‘‘ ‘‘	315, Aug., 1929,	The Production and Marketing of Strawberries.
‘‘ ‘‘	318, Dec., 1929,	Cannery Tomatoes—Three Years' Tests of Varieties.
‘‘ ‘‘	326, May, 1931,	Effect of Applications of Sodium Nitrate Upon Apples.
‘‘ ‘‘	328, June, 1931,	The Corn Earworm Biology and Control.
‘‘ ‘‘	329, Oct., 1931,	Corn Silage Production.
‘‘ ‘‘	333, May, 1932,	Fertilization of Early Potatoes.
‘‘ ‘‘	334, June, 1932,	The Poultry House Floor.
‘‘ ‘‘	337, Sept., 1932,	Organization and Management of Maryland Farms.
‘‘ ‘‘	341, Dec., 1932,	Housing Conditions in Relation to Farm Labor Turnover.
‘‘ ‘‘	344, Mar., 1933,	Some Effects of Freezing on Milk.
‘‘ ‘‘	345, Mar., 1933,	The Control of Tomato Diseases.
‘‘ ‘‘	346, Apr., 1933,	The Sources of the Food Used by Maryland Farmers.
‘‘ ‘‘	347, May, 1933,	Oat Variety Tests.
‘‘ ‘‘	348, May, 1933,	Corn Earworm Studies.
‘‘ ‘‘	352, July, 1933,	Farm Tenancy and Leasing Systems in Maryland.
‘‘ ‘‘	353, July, 1933,	The Factors Influencing Red Color on Apples.
‘‘ ‘‘	354, June, 1933,	Rations for Calves.
‘‘ ‘‘	355, Aug., 1933,	An Economic Study of 147 Turkey Flocks in Maryland.
‘‘ ‘‘	356, Sept., 1933,	A Study of 70 Dairy Farms in Montgomery County.
‘‘ ‘‘	357, Oct., 1933,	Part-Time and Small-Scale Farming in Maryland.
‘‘ ‘‘	358, Jan., 1934,	Fertilizer Tests with Tobacco.
‘‘ ‘‘	359, Feb., 1934,	Feed Consumption of Laying Hens.
‘‘ ‘‘	360, Mar., 1934,	Maryland Wheat for Cake and Biscuit-Making.
‘‘ ‘‘	361, Mar., 1934,	Part I, Potato Seed Maintenance.
‘‘ ‘‘	363, May, 1934,	Natural Weed Fallow for Tobacco.
‘‘ ‘‘	364, June, 1934,	The Oriental Fruit Moth in Maryland.
‘‘ ‘‘	365, July, 1934,	Roadside Markets in Maryland.
‘‘ ‘‘	366, July, 1934,	Studies on Firmness and Keeping Quality of Fruits.
‘‘ ‘‘	367, Aug., 1934,	A ‘‘Weigh-Back'' System for Feeding Laying Hens.
‘‘ ‘‘	368, Sept., 1934,	Spray Residue Removal from Apples.
‘‘ ‘‘	369, Sept., 1934,	Equine Encephalomyelitis.
‘‘ ‘‘	370, Nov., 1934,	The Physical and Chem. Properties of Red Clover Roots.
‘‘ ‘‘	371, Dec., 1934,	Fruit-Rotting Sclerotinias.
‘‘ ‘‘	372, Jan., 1935,	Nitrogenous Metabolism in Irish Potatoes During Storage.
‘‘ ‘‘	373, Feb., 1935,	Permanent Pastures in Maryland.
‘‘ ‘‘	375, May, 1935,	Responses of the Tomato to Certain Essential Elements.
‘‘ ‘‘	377, June, 1935,	Miscellaneous Studies on Poultry Grit.
‘‘ ‘‘	378, July, 1935,	A Survey of the Sheep Industry of Maryland.
‘‘ ‘‘	379, July, 1935,	Fattening Thin Native Lambs.
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‘‘ ‘‘	381, July, 1935,	Tax Delinquency in Maryland.
‘‘ ‘‘	382, July, 1935,	Production, Marketing and Consumption of Tobacco.
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‘‘ ‘‘	389, Nov., 1935,	Menhaden Oils as an Antirachitic for Poultry.
‘‘ ‘‘	391, Jan., 1936,	The Relation of Physical Properties and Chemical Composition of Red Clover Plants to Winterhardiness.
‘‘ ‘‘	392, Jan., 1936,	Blackhead (Infectious Enterohepatitis) in Turkeys.
‘‘ ‘‘	393, Feb., 1936,	The Properties and Stability of Whipping Cream.
‘‘ ‘‘	394, Mar., 1936,	Sale of Dairy Products at Roadside Markets in Maryland.
‘‘ ‘‘	395, Apr., 1936,	The Vaccination of Baby Chicks Against Fowl Pox.
‘‘ ‘‘	396, May, 1936,	Part I. The Farm Credit Situation in Maryland.
‘‘ ‘‘	397, July, 1936,	An Economic Study of 99 Poultry Farms in Maryland.
‘‘ ‘‘	398, July, 1936,	Production and Feeding of Early Lambs.
‘‘ ‘‘	399, July, 1936,	The Corn Earworm.
‘‘ ‘‘	400, July, 1936,	The Vinegar Gnats or Pomace Flies.
‘‘ ‘‘	401, Aug., 1936,	Manual for Milk and Cream Testers in Maryland.
‘‘ ‘‘	402, Aug., 1936,	Studies of Incubation Factors in the Agglutination Test For Pullorum Disease.
‘‘ ‘‘	403, Sept., 1936,	Strawberry Fertilizer Studies in Maryland.
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‘‘ ‘‘	414, Feb., 1938,	Metabolism in the Corn Ear Worm. I. Studies on Fat and Water.
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‘‘ ‘‘	416, Apr., 1938,	Winter Barley in Maryland.
‘‘ ‘‘	417, June, 1938,	Effect of Castration of Lambs on Their Development and Quality of Meat.
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DO NOT CIRCULATE

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